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BIOLOGICAL PHOTOGRAPHIC ASSOCIATION

FOR THE FURTHER STUDY OF PHOTOGRAPHY IN RELATION TO THE BIOLOGICAL SCIENCES AND TO IMPROVE ITS TECHNIC

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Mr. Carl W. Mueller, Easton Hospital, Easton, Pa.
Mr. J. S. Nicholas, Osborn Zoological Laboratory, Yale University, New Haven, Conn.

They will make nominations for the offices of President, Vice-President, Secretary, and Treasurer—all to serve for one year—and two Directors to serve three years.

If you are interested in the welfare of your Association, and you should be, you can show it by writing to any of the members of the committee and recommending to them suitable candidates.

The Executive Board—the Officers and Directors—a total of twelve, carry on all the business of the Association, the JOURNAL, formulate the policy, and spend the money. If these things have not been to your liking in the past, and you know who would do them better, this is your chance to make a change.

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EDITORIAL

WITH the present number, the JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION begins its seventh volume. Because of the change that has recently been made in the publishers as well as in the editors, future issues of the JOURNAL will show some differences from former volumes in appearance and make-up. The most important is the change in the type of illustrations used, and their distribution. In the future, the pictures will be processed by the full-tone (collotype) method; and instead of scattering them throughout the text, they will be assembled as full-page plates, placed with the text which they are to illustrate. Diagrams and pen drawings will appear as text-figures. The plates will be faced by full descriptions of the materials shown and the technique employed. The text pages will be printed on non-glossy paper which is comfortable for reading.

The new printers, E. L. Hildreth & Co. of Brattleboro, Vermont, printers of the *Yale Review*, are cooperating with us to bring about some needed economies which will in no way detract from the quality of the JOURNAL. An arrangement has been made through them to take charge of publication for a period of five years. An active campaign will be inaugurated to secure advertisers. Our members should join them in this effort, as any profits that the publication may earn will be shared by the Association. If some profits are realized we shall be able to compensate our editor, or editors, which has not been the case in the past.

Our former editor, Mr. Carl D. Clarke, who founded the JOURNAL and was also the publisher of the first volume, has tendered his resignation. His many duties as director of the Department of Art and Photography at the Medical School of the University of Maryland, and his more recent appointment as managing editor of the Journal of the School of Medicine of that University, have compelled him to take this action.

We congratulate Mr. Clarke and deeply regret losing him; we shall miss him on the JOURNAL. When material was scarce he was always ready with some informing personal contribution. We hope that he will continue with us as an interested and enthusiastic member.

The Executive Board at its recent meeting, with six members present and holding three proxies, decided that the September number should be in charge of a temporary Editorial Committee, consisting of Miss Shiras and Messrs.

Schmidt, Harding, and Massopust. The future editorial policy and the selection of the staff were reserved for action at the annual meeting of the Board at the convention which is to be held in Philadelphia in September.

In the past our members have depended to a large extent upon a small group to supply papers for publication in the JOURNAL; while most scientific journals are offered too many articles, we have received too few. We need the cooperation of every member if the high standard of our JOURNAL is to be maintained. Some members may lack special talent for writing, but some well-directed questions may start a lively and instructive discussion.

Letters to the editor describing your equipment and working conditions, the question of a fair charge for various types of service, and many kindred subjects are all grist to our mill.

LOUIS SCHMIDT.

TECHNIQUE OF EYE PHOTOGRAPHY*

LAURANCE D. REDWAY, M.D.

and

ADOLPH MARFAING

THE technique of photography of the human eye is extremely complex. It involves the use of instruments which are not generally known or used, and it is, therefore, not a matter of wonder that few people appreciate the really great difficulties and obstacles in the way of its successful accomplishment.

The first obstacle is the matter of light itself. While light in certain quantities is readily acceptable to the human eye, this organ is provided with numerous defences to protect it against light in quantities which would be irritable or dangerous to its delicate structures. There is the winking reflex, the tendency of an individual to jerk his head away when light is suddenly thrown into the eyes. There is the lightning-quick rotation of the eye ball in the socket, turning the cornea away from the source of light. Additionally, there is the reaction of the pupil which contracts to a pin point in the effort to exclude injurious light. All these reflexes and automatic protective devices have to be overcome before successful photography of the eye, either externally or of its interior, may be done.

Clinical photography done with the ordinary clinical camera will portray

* From the Photographic Laboratory of the Eye Institute, New York, N. Y.

the eye as a detail of the face. This method of photography together with appropriate lighting with photofloods, usually three in number, is used to picture injuries, malformations, externally visible tumors, and is the least difficult of all the photographic techniques.

The one basic requirement for all eye photography is speed. In consequence, to achieve this, especially in the case of clinical photography of young children, it is our practice to use a photo-flash in addition to the basic photo-flood light, without sacrifice of modeling.

The second technique involves the use of the Leica or Contax camera, with the patient seated and his head fixed in a head rest. The camera is mounted on a columnar support which in turn rests upon a base having a forward and backward and lateral slide. The lighting is from a spot-light at approximately 30 degree angle from the optical axis of the camera. The advantage of this method is that it permits negatives of very high original magnification. In other words it is a low power photo-micrograph. Reverting to our former statement that the eye is a detail of the face, we may add that most of the structures behind the cornea are microscopic in their detail of structure. Most pathology of the globe both external and internal is microscopic, at least at the time of its inception or shortly thereafter. To show this microscopic detail without becoming involved in secondary magnification by projection and thus encountering the annoyance of grain structure, it is necessary to resort to high original magnification as set forth by one of us in previous papers in 1929. Recent improvements in color film have made this medium almost one of choice for this type of low power microscopy.

Photographs of the interior of the eye are obtained with an instrument, the Nordensen camera or photographing ophthalmoscope. This instrument is a complex optical device consisting of a reflex camera mounted at the end of a telescope. Nearly in the optical axis is a partially silvered prism from which the rays of an arc lamp are projected through the front member. The problem of photographing the interior of the eye is exactly similar to photographing the interior of a closed room through the key-hole of a door leading into it. A sufficient volume of light must be gotten into the room through the key-hole to illuminate it sufficiently to permit the picture to be taken also from the outside by the light which is reflected back through the key-hole and into the camera. In order that sufficient field may be obtained the lens must be of relatively wide angle, short focus and fast, since the diameter of the pupil in wide dilatation is barely greater than 11 mm. The technique of fixing the patient's eye together with the focusing of the light beam and of the camera is one of considerable nicety, requiring great patience and much cooperation on

the part of the patient. Good photographs in black and white and in color may be obtained by this method. But, unfortunately, distortions from various causes in the clear ocular media; also opacities existing either in the cornea or the lens or the vitreous body of the eye frequently prevent good photographs of those cases in which the physician's interest is greatest. However, the older art of drawing the fundus which has been brought to such perfection by Mr. and Mrs. Bethke can be resorted to in cases of this kind since the interfering fog can be ignored.

The study of keratoconus has developed several new techniques, one of them photographic. The idea behind this is that a plain mirror or a spherical mirror will give an undistorted reflection of a light source. Any distortion of or stress in the surface of either the plain or the spherical mirror will produce a corresponding distortion of the image of the light source. This principle has been utilized by construction of a placido disk consisting of alternate black and white circles on a ground glass plate. The ground glass is mounted in a box containing electric light bulbs, the inside surface of which box is painted white. An aperture is made in the glass at the exact center of these concentric circles and also in the back of the box. A Leica camera is mounted at the back of the box and the patient is seated in front of the diffusely illuminated circles. The surface of the patient's cornea, if this is normal, is a spherical mirror reflecting the alternate black and white circles into the camera lens. With the lids held widely open the patient's cornea is photographed. If any scar exists, or if the cornea, as in the case of keratoconus, is not a spherical mirror but a conical one corresponding distortions of the rings of the placido disk occur.

An additional technique developed by Mrs. C. L. Stevens consists in making plaster moulds of the cornea. While the distortions of the lines of the placido disk provide a contour map of the cornea, Mrs. Stevens' moulds provide a relief map which, in conjunction with the contour map enables a study to be made of increases or decreases in the height of the cone together with distortions of its surface.

Much progress has been made within the last two years in the matter of materials for color photography. Without prejudice to any other processes, we have found that the Dufay color film and the Eastman Kodachrome seem to fulfill our requirements best. Since speed is a primary necessity we must deal with relatively sensitive emulsions. Good results can be obtained with either of the above named materials. The Kodachrome has the advantage that there is no silver grain, but it cannot be processed in the laboratory. The Dufay film has the disadvantage of the ruled grid and the presence of silver grain, but, in that it may be processed in the laboratory directly, it has the advantage

over Kodachrome where it is necessary or desirable to obtain a rapid result. In general the expense of color materials has been a severe handicap to their more general adoption, for one thing, and the difficulty of securing good color prints for another. The latter obstacle has been a severe handicap in eye photography, since almost more than in any other field of technical photography, good color rendering is essential.

It will be apparent from the foregoing that a great many of the difficulties inherent in the photography of the living human eye have been overcome. While our pictorial results are not by any means perfect, they are good considering the limitations of the materials. It would be desirable if at least 80 per cent of the technical photography of the eye could be done in color, but this awaits a cheapening of the color processes and a rapid and simple method for the production of color prints. When these two remaining difficulties are overcome the technical problems of the photography of the living human eye will be about 90 per cent solved.

This subject, by the same authors, will be elaborated at the Philadelphia Convention using photographs, lantern slides, and moving pictures with sound.

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HOW TO MAKE YOUR CAMERA SELF SUPPORTING*

NORMAN R. GOLDSMITH, M.D.

New York City

"HOW are we ever going to keep on?" disconsolately asked the man who occasionally took pictures for the hospital. "The photographic budget's been slashed to pieces. If there were only some way we could make a little extra income. . . ."

And here is a way.

There are hundreds of small hospitals throughout the country which have excellent X-ray departments but are completely unawakened to the possibilities of clinical photography. It is your job to make them and especially their

* Received for publication June 20, 1938.

physicians aware of the many ways photographs can help. As a byproduct your own shrinking budget will be helped.

Who wants pictures? Practically everybody providing you can interest them. The way to arouse hospitals is first to awaken the doctors on the staff to the uses of photography. What doctors want pictures? Again, almost all providing you can show them how photographs can be useful. Those most desirous of pictorial records are surgeons, especially those doing considerable plastic work for whom photographs are an actual necessity; dermatologists; and pathologists. Secondary groups are pediatricians, endocrinologists, fracture experts, ophthalmologists, and the like. But actually almost any physician would be glad to have pictures of his cases occasionally if he were only made aware of the possibilities.

In general, medical photographs fall into two classes—the before and after type and the unusual cases. Both terms are self-explanatory. Typical of the first is the patient with the severe skin eruption. A new treatment is employed. A month later the skin is as blemishless as a cold cream girl ad's. A sample of the second is the woman who weighed 155 pounds. After a tumor is removed from her abdomen, she weighs 75 pounds. Pictures of the patient before and after, and of the removed tumor suggest themselves.

An intermediate type of picture is that showing the development or regression of a condition. A man has a pituitary neoplasm. Pictures of him first as a normal individual; then the first signs of gigantism; finally the fullblown picture of acromegaly with spade hands, huge stature, enormous jaw and widely separated teeth.

Some more ideas for picture possibilities. An orthopedist has in addition to routine X-rays, photographs of all fractures he corrects if for no other reason than to silence unjustified complaints that he produced a deformity. A surgeon who performs many thyroidectomies always has before and after pictures taken. The contrast between the skinny, goitrous, bulging-eyed invalid and the plump, healthy convalescent is often amazing. Another surgeon who cares for many industrial injuries has pictures taken of all cases as soon as they reach his office. Still another does the same with those injured in automobile wrecks. Often the pictures play an important role in subsequent law suits.

Plastic surgeons are especially prone to take many before and after photographs. Views of the face from all angles showing the new and old shape of the nose, relation of the contours, and the like are always indicated in this specialty. Dermatologists like to show skin tumors and atypical lesions. Dentists are eager to record teeth malocclusions which they have corrected.

The unusual cases are legion. Survey of many state medical journals, the

national ones are generally pretty good now, reveal a distressing state of photographic work. Some of the pictures would shame even the girl with her first box camera. There is no concept of backgrounds or the necessity of showing one aspect well instead of a multitude of confusing, nonessential details. Whenever a doctor reports an unusual case, often he does so at hospital monthly meetings prior to publication, attempt to interest him in the photographic possibilities. Pictures will often *make* his case report.

What equipment is needed? Of course, all things being equal, the better the equipment the better the photographs. But excellent pictures can be taken with medium-priced cameras. In the final analysis it is the person behind the shutter which determines photographic success. Naturally, certain types of work demand expensive apparatus but for the average picture for the average physician, average equipment is sufficient.

What is the minimum equipment to obtain satisfactory results? A camera with a ground glass focussing device is advisable especially for skin pictures. The lens need not be superfast. A miniature camera of the 35 mm. variety, because of the large number of pictures which can be taken and the fact that that size film is standard for many projectors, is helpful. Get a portrait attachment and copying lens. Photofloods with reflectors and a photo-flash synchronizing device insure many otherwise doubtful pictures. A green filter helps bring out many skin lesions. An enlargement will often supply the picture that the particular lens is unable to get close enough to. Prints should be glossy, sharp, and contrasty—the same requirements as for good news pictures.

Once the medical staff is aware of what can be accomplished photographically, it is quite possible various of its members will advance funds for the purchase of expensive equipment. Thus, a surgeon who had developed a special type of fracture bed, became so interested in the pictorial aspects that he bought for his hospital's part time photographer a complete set of accessories.

Much of the work of a hospital centers around the pathology department. Photographs of operative specimens are often needed. Many institutions lack facilities to keep all their specimens so nothing remains but a photographic record. Pictures of autopsies are a common procedure. A good technique if you have a fairly adequate 35 mm. camera is to make a roll of a case history for clinical or medical society meetings. You can start with the typewritten abstract of the case on the film; then pictures of the patient, his temperature curve, copies of the clinical charts, and summaries of the laboratory findings. If there has been an operation, a pictorial record is a useful insert. X-ray films may be photographed and included in such a story. And finally any

gross or microscopic pathological specimens. The whole may then be projected at the medical meeting and greatly amplify the descriptions of the physician.

With color, Kodachrome transparencies may make such a clinical report even more interesting. Fairly good photomicrographs may be made with ordinary equipment after a little experience. Moving pictures are an expansion but not too costly a one when taken intelligently and when their effectiveness is considered. Surgeons especially like them to show the benefits of operations on crippled limbs and neurologists are eager to record atypical gaits, spasms, tics, and the like.

Nor have all the possibilities for hospital photography been exhausted. There are many profitable sidelines open to the man with a camera in an institution. Nurses and internes always need photographs for applications. Candid shots of hospital personnel—memory book stuff—are usually good for small sales. Interiors or views of the grounds are frequently bought by patients. Print them on post cards. Nurses' year books require lots of photographs. You might as well take them. And of course there are always the photographs of babies for proud parents.

Another sideline is pictures for newspapers or the picture services. The boy who swallowed the whistle and had to have it taken out of his lung. The girl who can't stop laughing. The national celebrity injured in an automobile wreck and recuperating at your hospital. The giant. The dwarf. The triplets. Get your ideas from the picture magazines and syndicate photographs. But be certain of one thing. Be sure the patient, the physician, and the institution give you permission first. A signed release will save you much grief. Physicians' ethics are one thing you must appreciate. Whereas some professions eat up photographic publicity, the reputable physician frowns at having his picture in the paper especially if it be in action. Before releasing any photographs to papers, be sure you have the physician's permission. And don't steal one on him. You might get away with a picture today, but there is always a tomorrow.

There is the pictorial side, too, for magazine illustrations. Forget your patients for a minute and see the marvellous angle shots of white gowned figures, shining sterilizers, gleaming instruments, dazzling glassware. Or snap children in a hundred poses with a view to advertising agency purchase.

So here are some ideas on how to make your camera self supporting. The keynote of the article is this—arouse people to the possibilities of photographs. When you have done so, become *the* clinical photographer of your particular district. Good luck!

IDEA-SESSION OF THE PITTSBURGH LOCAL CHAPTER*

Reported by
ANNE SHIRAS
Secretary of the Pittsburgh Chapter

A PART of the March meeting of the Pittsburgh Chapter was given over to an idea-session for all present by all present. The notice read:

"Bring two or three ideas that have been useful to you in your photography. They may be specialized or general, original or borrowed, home-made or commercial. It does not matter how simple the subject may be—the simplest are often the most useful. . . . Let us remind you that the exchange of ideas and methods is one of the prime objects of our Chapter. This type of meeting can be the most instructive of all if everyone will enter in."

Needless to say, everyone did not enter in. . . . But enough members presented items to make the following Journal report seem worth while, even without the demonstrations that accompanied them.

Control of Light in Projecting Kodachrome Film Slides

Mr. Albert Levin, photographer at the Montefiore Hospital stated that in the projection of colored film slides the tendency to pass as much light through the film as is possible with the illumination available has resulted in the poor appearance of many fine plates. In thin, delicately colored plates the excess light frequently "burns out" fine detail. The use of an iris diaphragm in the lens system of the projector has been found to be of great help in regulating the intensity of the image on the screen, so as to show these plates at their best.

Mr. Levin showed a number of slides, controlling the light to illustrate his point. The use of a rheostat unit to control the current and consequently the light intensity, was also recommended by some of the members present.

Keep Posted on the New Emulsions

Mr. Levin made a plea for photographers who are limited either by lenses of relatively small apertures or by scarcity of lighting equipment to keep informed

* Received for publication June 10, 1938.

about the high speed emulsions being developed by some of the leading film manufacturers. For example, if enough light cannot be thrown on the working field to ensure sufficient depth of focus, or if in order to stop motion in certain subjects, one has to work at a speed which demands a larger lens aperture than the depth of field requires, the substitution of a film twice as fast as the one regularly employed may save the day by allowing the use of the next smaller stop.

It is a fact that under pressure of the "fast lens" craze, many photographers will buy and tote around expensive wide aperture lenses for a few pictures that their old lens could perhaps take just as well with a fast film as ally. In the past year emulsions have been brought out that are two to three times as fast as the films we formerly considered our fastest. They should be investigated by every photographer and kept on hand for a time of need.

Telephoto Shots, Minus Tripod

Professor George Thorp, of the Carnegie Institute of Technology, Department of Aeronautics, is making slow-motion studies of bird-flight. A telephoto lens is a necessity, to bring his bird close enough for study; but with so unpredictable a subject, the use of a tripod is out of the question. How to eliminate camera-motion, under the circumstances?

The accompanying sketch shows Professor Thorp's solution. A magazine-type 16 mm. movie camera is attached at the regular tripod attachment point to one end of a 1-inch aluminum alloy angle by a ¼ inch screw, in such a way that the camera may be loaded without removal from the angle. A wooden handle 1″ x 1½″ x 5″ is attached vertically to the other end of the angle by a screw and nut. The camera may easily be detached by the use of a penny or dime as a screwdriver. The handle may be folded along the angle.

In use, the camera is pressed firmly against the right cheekbone, so that the right eye is in proper position for sighting. The right hand grips the camera and angle from below with thumb at left and fingers to right of camera, and forefinger on the operating lever. The left hand grips the wooden handle, and the angle should be long enough to straighten out the operator's left arm in a comfortable reach. The camera is aimed like a gun, except that it is placed against the cheek instead of the shoulder. A high degree of steadiness about all three axes is secured by this simple device.

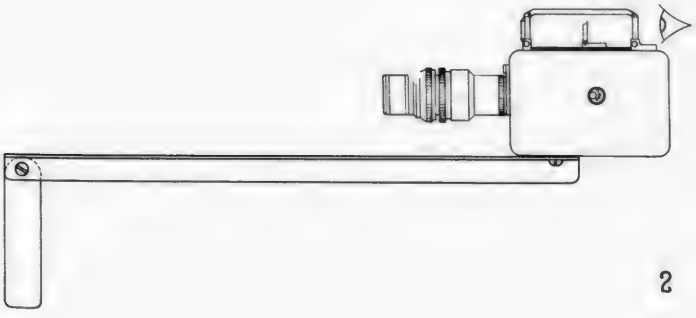
What Went Wrong?

In the picture opposite, here is what happened: When the electric current was passed through the flashlight bulb, the bulb exploded and particles of glass

1

WHAT WENT WRONG WITH THIS PICTURE?

The photograph was taken in a basement fixed up as a bar. The room was dark except for the lighted candle. A 3¼ x 4¼ supersensitive panchromatic film pack was used at f/16. The illuminant was a #10 flash bulb in a reflector held above and behind the camera. There were no glass doors nor any other reflecting surfaces. The shutter, set at time, was opened while bulb was set off, and promptly closed. Developed in D-76 in a totally dark room, the negative showed the curious markings seen above, while all the other negatives in the pack were good. What happened? The answer appears in the accompanying article, and concerns all of us!



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UNIV. OF MICH.

and burning foil flew in curved paths in front of the lens for a distance of six feet. The streaks of light in the picture were exposed by the burning foil. Anyone in the path of these particles could easily have been cut or burned. Dr. W. Harry Archer, who took the picture, was impressed by the force of the explosion. He began experimenting with flashlight bulbs and made some interesting discoveries.

A bulb will explode when it is cracked or contains a thin spot in the glass. The thin spot is a manufacturing flaw and cannot be detected by the user, but a crack large enough to explode a bulb is easily visible. Dr. Archer cracked bulbs experimentally by heating them around the middle over a Bunsen burner and quickly running cold water over them.

They do not explode easily! The manufacturers make them with care and inspect them rigorously. Within recent years a thin transparent lining has been inserted which adds strength and reduces the shattering considerably. One brand recently placed on the market has a small colored spot on the inner surface which gives a danger warning by changing color if the bulb has been damaged sufficiently to permit air to enter. Even deliberate attempts at explosion often fail because if the bulbs are cracked beyond a certain point they will not light at all; and, if they are only finely cracked, they light without mishap.

However, they *can* explode, as Dr. Archer convincingly illustrated by blowing several in succession at the meeting. And in spite of all the manufacturers' precautions they sometimes go off unexpectedly. The following is quoted from the wrapper of a well-known brand:

"Warning: Although these photoflash lamps are made with exacting care from selected materials, and are carefully inspected before shipment, under certain conditions a lamp may crack or shatter. Therefore the photographer should always stand behind the lamp, using the reflector as a shield, and the subject photographed should be located a safe distance from the lamp. Use care in removing lamp from the socket. Do not flash in explosive atmosphere without safety equipment."

This is the manufacturer's protection against possible injury-suits resulting from an exploded bulb. But what is the photographer's protection, in the close-ups required by oral work, eye-photography, pictures of lesions, etc.? There is only one way to feel completely secure: *shield your bulb.* The "safe distance" mentioned in the warning may be considered as about six feet. Do not take a picture or permit anyone to take a picture of you at less than this distance without protection. This is a particularly important precaution when the equipment used is one of the new combination camera-and-photoflash-reflectors recently placed on the market. In this type the camera, with light-

source, is focussed within inches of the subject and by its very construction would direct the flying particles into the photographic field. Dr. Archer found that a clear sheet of acetate cellulose, the thickness of X-ray film, effectually stopped all fragments without materially reducing the light nor affecting picture quality. This material has the added advantages of being light, nonbreakable and readily available. A pane of glass, placed before the reflector, also stopped the particles without cracking, but glass may break in transportation and is cumbersome to use. Cellophane is not recommended, as it was found to ignite when struck by burning foil.

The flashlight bulb is a useful accessory. Most of us resort to it at one time or another; some of us use it routinely. The chances are we are safe in doing so. But let us make it a B.P.A. procedure to rule out chance entirely. It takes only a little extra effort to shield your bulb, and the sense of security is worth it.

Treatment of Motion Picture Film to Increase Durability

At the request of the Board, Mr. George Ryan, of Ryan Motion Pictures, investigated and reported on the Peerless Film Processing Corporation's Vaporate Treatment of motion picture films. The treatment consists of subjecting exposed and developed film to a vacuumizing treatment in which vaporized chemicals are combined with the emulsion in order to give heat and moisture resistance and other desirable properties. Mr. Ryan read excerpts from the report of the New York Testing Laboratories on various tests they had conducted for the Peerless Film Processing Corporation on processed and unprocessed film ("processed" in this case being used to denote film that had been subjected to the Vaporate treatment). The result of the tests, which appear to have been conducted with thoroughness, can be summed up as follows:

The processing of the film does not affect smoothness of projection.

The oil picked up on the surface of processed film after continuous projection was not as great as that picked up by unprocessed films under similar conditions; hence the resulting oil-flicker was less in the processed film.

Processed film is far superior in hardness and abrasion resistance.

The melting point of processed film is considerably in excess of the unprocessed film.

Film is less brittle, under the cold test, after processing.

Mr. Ryan read testimonials sent to the Peerless Process Company by well-known motion picture companies. It is, of course, vital to these companies that their films be made durable as possible without loss of quality. They appeared to be satisfied with the Vaporate treatment after the processed films

had been subjected to long runs of several projections a day. Mr. Ryan said that on the strength of these testimonials and the unequivocal statements of the Testing Laboratories he was sending his own films to be treated, and was also performing this service for his customers.

The Peerless Film Processing Company advises the Vaporate treatment for color-film as well as black and white stating that: "there is no coating, no liquid wash; the reaction is in the substance, not on the surface. With no effect on light or color values, the physical properties of the emulsion are adapted to meet the demands of time and use."

Photographs of Lightning

Mr. Charles Agostini, Section of Education, Carnegie Museum, showed the lightning pictures reproduced here (Fig. 3) stating that they were made during a thunder storm about 10:30 at night with an Argus 35 mm. camera at f/4.5, bulb exposure. He asked what caused the peculiar markings appearing to a greater or less extent in each picture. One member suggested they might be electrical discharges along telegraph wires, but Mr. Agostini ruled this out as there were no wires in the position or direction of the markings. It was then suggested that as the component parts of the Argus lens are separated by air chambers, the markings might be caused by glare in the air chambers on the various surfaces of the lens components. This idea was skeptically received by several of the members, but they had no better suggestion to offer. Has anyone an explanation for these peculiar light patterns? (See illustration facing p. 14.)

Modelling Clay as a Useful Accessory

Miss Anne Shiras, photographer for the Department of Medicine, University of Pittsburgh Medical School, advocates non-hardening modelling clay as a handy-man around the workshop. It is useful for propping gross specimens or small objects into the required positions. It can also be made into columns to hold your ruler at the right focus-level in pictures where measurement is necessary. A convenient way of doing this is to keep molded columns on hand; measure the height of the most important plane in the object you are going to photograph; measure off the same height on your clay columns; stick pins in them at that point and rest your ruler on the pins. In this way you need never give up the best focussing of your object for some compromise plane which will sharpen up the ruler at the same time. The clay columns themselves can be kept just outside the photographic field or can be masked out on the negative

so that only the ruler shows. Art supply stores sell non-hardening clay for about 30¢ a pound. A pound will go a long way.

Removing the Emulsion from Lantern Slide Plates

Many workers prefer to buy cover glass rather than use their discarded lantern slides, because it takes time and effort to scrub the emulsion clean off the plates. However, to throw away glass with one hand and buy it with the other seems poor husbandry, even though cover glass is cheap.

There are easier ways of removing the old emulsion than by straight soap and water. Miss Shiras recommended putting your slides, as you discard them, into a covered jar containing a ten to twenty percent solution of sulphuric acid. The acid will dissolve the emulsion and when the time comes to use the slides they can be cleaned off quite readily with soap and water.

A rinse in a solution of sodium fluoride, followed by the sulphuric bath, will enable you to strip the emulsion cleanly off the glass in one piece. The Hammer Dry Plate Company recommends the following formula for this:

Solution A

Sodium Fluoride	60 grains
Water	8 ounces

Solution B

Sulphuric Acid C.P.	1 dram
Water	8 ounces

Both solutions can be used until exhausted. Place the negative in Solution A for a couple of minutes and then place directly in Solution B. After another few minutes, raise the film from one corner with the finger—it will soon leave the glass.

Focussing on 35 mm. Positive Film Strips

Dr. Josiah Eisaman described a simple method for focussing the negative image on positive film under the best light conditions:

When making 35 mm. positive film strips several devices may be used. The camera (lens removed) may be loaded with positive film and images projected on to it may be exposed frame by frame. For greater convenience, however, the standard 35 mm. printer is advisable. Because of the difficulty of focussing a projected image on the small film surface under subdued light, a dummy focussing apparatus is recommended.

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This consists of a small block of wood conforming to the measurements of either camera or printer. Care must be exercised that the thickness of the wood is exactly the same as the distance from the film to the back of the printer. This measurement can easily be obtained with callipers.

The block is coated with black paint and upon one broad surface a clean white rectangle 1″ x 1½″ is painted. Images may easily be focussed on the rectangle by brilliant illumination. The focussing device is then replaced by the printer and sensitized film under a ruby light.

Copying Miniature Film

Dr. M. A. Hershenson described his method of copying Kodachrome or black-and-white miniature film. He simply puts the film in a projector, faces the projector with his camera (large, miniature or sub-miniature) and interposes a sheet of ground glass between the two. The image is thrown by the projector on the ground glass and copied by the camera. It is helpful to have a ground-glass focussing back in the camera, not only for critical focussing, but so that the image may be studied and the best field chosen. As to the light source in the projector, the main thing is to have it bright enough so that your image can be read with an exposure meter. In fact, the possibility of using a meter is one of the great advantages of this system.

Dr. Hershenson was asked whether there was any glare caused by light spilling around the edges of the ground glass. It was suggested that a good procedure would be to remove the lens from a copying camera, place your projector in front of it and shoot the image right through the camera onto the ground glass, photographing it from the other side with another camera. Dr. Hershenson said that would probably be feasible but he had never been troubled by stray light nor found it necessary to mask his ground glass screen. He uses a 11″ x 14″ glass as there are decided advantages in projecting a large picture and reducing it down again. He has not experimented with copying Kodachrome in color, but sees no reason why it should not work, as the projected image is brilliant.

Mounting Positive Film Strips

There are two great disadvantages to positive film strips: the pictures are in an unalterable sequence which may not suit all occasions, and the emulsion gets scratched in projection. Dr. Hershenson gets around both these drawbacks by cutting the positives apart and sewing them side by side, emulsion down, on a

piece of clear 35 mm. film. (It is more satisfactory to remove the emulsion entirely from the supporting film than merely to clear it in hypo.) A whip-stitch can easily be run through the perforations, without sewing the film itself. There are plenty of perforations per picture to hold each one securely. However, by using a different thread on every few pictures you are ensured against having your whole lecture fall apart if one thread comes untied in projection.

The threads can easily be snipped and the sequence of pictures rearranged whenever necessary. Color can be interspersed among black-and-whites, and the emulsion side of the positive is protected against scratching. In fact you have all the advantages of lantern slides combined with the lightness and simplicity of the film strip.

So ended the first Idea-Session. We hope, now the ice is broken, to make it an annual event and to have some useful ideas to report to you yearly. We would welcome some competition. How about it, Boston, Philadelphia, New York?

COLORED LIGHT, FILTERS AND PHOTOGRAPHY[1]

DR. OSCAR W. RICHARDS*

PHOTOGRAPHS are usually made with colored light imaged on a plate by a lens. White objects and white light photography are less common. With white subjects it is customary to build up sufficient detail in the negative, so that only the white paper will show when the positive is printed as is done in line work. However, when the subject matter is not pure white the difficulties of color enter.

A photograph is an unique record of many details and consequently any factual recording with much detail may be called photographic. For the purpose of illustration a drawing may be superior to a photograph. The artist may omit part of the background in his drawing or may intensify certain features of the drawing by slightly exaggerating them. When medical or biological subjects are to be shown in a photograph, it may be desirable to modify the photograph so as to suppress some of the detail and emphasize that part of the picture which is of primary importance. Our fundamental problem then is, just what does the eye see? It is that picture which we are to record in the

* Research Section, Spencer Lens Co., Buffalo, N. Y.

[1] Read before the Convention of the *Biol. Photogr. Assoc.* at Rochester Sept. 1937.

photograph and on this basis will the observer decide whether it is a good or a bad photograph.

A beam of light passing through a prism emerges with its component colors separated to form a spectrum. The red light is at one end, followed by the orange, yellow, green, blue and violet. That is all the light seen by the eye, although we know that the radiation extends in both directions, because under certain conditions it is possible to make photographs with the ultra-violet or the infra-red radiation. A mixture of colored light of the proper proportions appears to the eye as white and the light passing through a prism may be recombined into white light when the mixture is of this kind. Should the mixture be such that one color of light, the red for instance, predominates, then the light would appear red, or reddish, instead of white. When the intensity of white light is gradually diminished, the eye recognizes the changes as giving shades of gray, until finally there is too little light for the eye to see with and the object becomes black.

These features might be demonstrated to advantage by projecting a spectrum on the screen and holding different filters in front of the light so that what happens when light passes through a colored filter could be seen, or, when it is reflected by colored paper. It is not practical to do this, because the equipment required would not be conveniently portable. By means of a pocket spectroscope and one of the filters of the Eastman observation filter card held in front of the spectroscope, certain regions of the spectrum may be seen to be absorbed by the filter. The color of the filter is due to the light which is transmitted to the spectroscope and through the spectroscope to the eye. Colored paper mounted on a piece of cardboard demonstrates that the same results occur with reflected light. The color of the object is due entirely to the light that reaches the eye. The spectroscope shows that the rest of the light is absorbed and aids in the analysis of color.

Colored objects are colored because they absorb light of certain colors and transmit or reflect light of other colors. A lemon yellow, for instance, absorbs violet and blue light, but reflects or transmits the remaining colors of the spectrum. A magenta absorbs in the green region and transmits the rest of the spectrum, consequently such a color is called a minus green. A lemon yellow color is a minus blue. Sky blue is a minus red because all of the light except the red would be reflected to the eye by the object or transmitted through it in the case of a filter.

What is seen depends upon the limitations of the eye. For the purposes of this paper, it will be assumed that errors of vision such as near or far sightedness are corrected by appropriate glasses. In the retina, which lines the back

part of the eye, are cells containing a purplish pigment. The pigment is bleached by light, the resulting chemical products initiate nerve impulses, and when these nerve impulses are received by the brain we recognize them as sensations of color. Colors are seen for which the sensitive elements of the eye absorb light of that wave length, but the retina is not equally sensitive to all colors. Since the eye is more sensitive to the yellow-green than to other colors, an object which is green will seem brighter than one of similar intensity, but of a different color. The sensitivity curve shows that the eye is progressively less sensitive to colors toward the red and the blue ends of the spectrum.

All eyes are not equally sensitive to color. In some individuals the eyes may be blind to a certain color, while in others color deficiencies may occur wherein the individual is not strictly color blind, but does not recognize all colors equally well. It sometimes happens that the two eyes of the same individual are not equally sensitive to color.[2]

The Westcott color slide[3] may be used to advantage in showing some of the problems of color vision. The test slide consists of three large patches of color at the top of the screen, and forty different numbered colors. This slide may be placed in a lantern slide projector, and when projected on the screen it serves as a convenient means for testing a group of people at one time. The individuals tested write down a list of numbers of all of the greens among the forty colors, then of the other two main colors which are varieties of red. A color blind person will add grays, browns and roses to the list of the greens. Successive tests separate the red and violet blind from the green blind. The slides may be used to show to the normal eye approximately the way that color is seen by those who are color blind. Holding an appropriately colored magenta screen in front of the lantern changes the appearance of the colors to the normal eye to about that seen by the green blind. This filter makes the greens brownish or greyish. Red and violet blindness may be illustrated in a similar manner with green and orange filters held before the projection lens.

While about two per cent of men are color blind, it is rather unusual to find a color blind woman, although occasionally this occurs. More frequent is the individual who is partly color blind. A friend of mine sees a heather green as brown, and many green stained shingled bungalows are also brown to him. Shades of red are recognized by him which cannot be distinguished by the normal eye. However, by knowing what are his limitations in seeing colors,

[2] Judd, D. B., Color blindness and anomalies of vision. *J. Soc. Mot. Pict. Eng.* 1936, 26: 616–636.

[3] Westcott Color Slide Set. #87410. Central Scientific Co., Chicago.

he is able to carry on without undue difficulty, although he must be careful in dealing with the greens. Such cases of partial color blindness are not uncommon, and it behooves each photographer to find out exactly how normal is his or her color vision.

For practical application we should consider two problems: the chromaticity of the color and its intensity. The chromaticity is the redness, the greenness or the other coloredness of the light, and the intensity is a measure of the amount of the light available for use in making a photograph. When the intensity of light is low, it may be very difficult to distinguish its color visually, while if the intensity is high, the coloredness is more clearly perceived. Suppose we have to photograph an object which contains a red and a blue of equal energy. The eye will see these as distinctly different because of their color. No normal eye would confuse the red stained tuberculosis bacterium on a blue background of pus when viewing a microscope slide stained with the Ziehl-Nielsen method, but when this preparation is photographed, the photographic plate may record the colors equally intense. The red and blue may give equal blackening of the photographic plate and the detail is completely lost when their energy is equal in terms of the sensitivity of the plate or film.

Consequently, one has the choice of making the bacteria light against the dark background in the photograph, or, the background may be made light and the bacteria dark. Bright objects are more readily seen on a dark background than are dark objects seen on a bright background. Thus, we may solve the photographic problem by using a suitable reddish filter which will make the bacteria light, while the background is recorded darker by the photographic plate. In general, contrast is obtained by photographing the object with a filter which transmits to the plate the light absorbed by the object, and detail in the object is recorded with a filter which permits the light reflected or transmitted by the object to reach the plate. A filter which would give a maximum contrast, or a maximum loss of detail, is rarely used and a compromise is chosen to give the best results for the purpose intended.

Photographic plates or films, like the eye, are also not equally sensitive to all colors. We recall that the older photographic plates were most sensitive to the blue, so that any blue object photographed unduly light. Modern panchromatic emulsions are sensitive to all colors, although they may not have the same sensitivity to color as the eye. A given amount of contrast or detail in the object photographed can be obtained when we bear in mind the extent to which the film sees differently than the eye. Wedge spectrograms illustrating the sensitivity of any given emulsion to various colors of light are supplied by

the manufacturers. Knowing this sensitivity and the colors of the object to be photographed, the best filter may be chosen for the detail that is to be shown in the photograph.

Different light sources produce different balances of color. We are all familiar with the yellowish light of the tungsten filament lamp. Should the subject call for yellow filter, it is unnecessary to use the light yellow K-1 or K-2 filters with ordinary tungsten light. The whiter arc light contains more blue light. The filament lamp when burned at an over-voltage also gives a whiter light and this is the advantage of the photo flood lamp. The mercury vapor lamp produces little red light and has only certain colors, because the spectrum is composed of several intense lines placed at definite intervals instead of being a continuous color as is the spectrum of sunlight. North light, free from any direct sunlight, is blue rather than white. The nature of the colored light produced by the illuminant must be considered when planning the photography of any colored object.

All of these facts emphasize the importance of several arbitrary decisions that must be made before taking the photograph. First, what we wish to show depends upon the nature of the object in front of the camera as seen by the human eye. Second, it depends upon the sensitivity of the film that is to be used, and third, the nature of the light which illuminates the subject. The last two factors are discussed in many of the available books, so that it is not necessary to give further details here.

It is hoped, however, that the above comments may draw attention to the limitations of the eye and that they will assist in interpreting the subject and in planning the photograph. When we know what and how the eye sees, and decide what the photograph must show, then the choice of emulsion, filter and light becomes more or less arbitrary. Sometimes the only choice is in the emulsion that may be used, because the illumination may not be subject to direct control and the decision may resolve into whether or not to photograph. The increasing use of color films has emphasized this problem, and we know at present that photographs should not be made when there is too great a difference between the high lights and shadows. It may be wiser not to attempt a picture with these emulsions if the lighting is abnormal and not reasonably flat. What we are to record is what the eye sees, and the success of the resulting photograph will be evaluated by the human eye. The sense of color may be developed by continuous practice, and with practice the arbitrary decisions become easier. These suggestions are offered to facilitate the necessary compromise decisions on which the advancement of biological photography depends.

NEGATIVE ENLARGEMENT IN PHOTOMICROGRAPHY*

FRED A. METTLER, A.M., M.D., PH.D.

THE question of the mode of magnification of the slide object in photomicrography is answered by different photomicrographers in different ways.

Assuming that the photomicrographic apparatus is equipped with an achromatic, aplanatic and compensated lens system the usual procedure is, after the apparatus is centered, the illumination adjusted, and the slide focused by the use of a convenient power, to pull out the camera bellows to give full utilization of a rather large plate and then to make the negative exposure. If the limit of the bellows is insufficient the worker will swivel to the next objective and repeat the procedure of adjusting final size by bellows extension. In cases in which the equipment at hand does not include a negative enlarger, magnification of the projection of a given lens system by bellows extension is the only method available unless resort is to be had to double photography. (Making another photograph of the first or original positive.) It is hard, however, to conceive of a modern set-up which does not include an enlarger. The scientific worker will find the construction of such an apparatus a far simpler problem than those he encountered in arranging his photomicrographic set-up.

This routine is, however, much less satisfactory than the one about to be outlined for the following reasons: use of successively higher powers is less and less satisfactory as the thickness of the object photographed increases and also limits more and more the width of field. Moreover the farther the bellows is pulled out, the more the peripheral definition is sacrificed, the longer the exposure time becomes (often to inordinate periods, especially with filters), the greater the plate size must be (and consequently more expensive the individual exposure), and the closer the objective must be brought to the object beneath the cover glass (with thick cover glasses it may be impossible to get close enough).

In the choice of the objective the primary consideration should not be the size of the image projected upon the ground glass while focusing, but the de-

* From the Department of Anatomy, University of Georgia School of Medicine, Augusta, Georgia.

gree of definition it is ultimately desired to show. This may seem to be a mutually contradictory statement since we know that resolution depends upon the angle subtended by the object viewed and in general the greater the size of the object viewed the better the resolution. The reason why it is possible to make the above statement is because the perfectly focused negative is susceptible of subsequent enlargement and the size of the image originally projected upon the ground glass is relatively immaterial as compared with its definition. Size of the object, in photomicrography, should not be confused with degree of detail and the two can be independent of each other, as when the section is thick and a penetrating focus is desired. In such a case, although the resolution is theoretically increased, by increase in size, there is so much interference produced by thickness that fine detail is lost by distortion in the third dimension. In most cases it will be found that a higher power objective is chosen not for the greater degree of resolving power it affords on a given shallower plane but simply for an increase in the total size of a slide object already clearly seen in smaller size with a lower power. If greater lens resolution is what is truly wanted then there is no escape from the use of a greater numerical aperture system (more powerful lenses). The bellows should never be extended in a vain effort to increase lens resolving power, for such a result is impossible by that means. Pulling out the bellows-back actually spoils peripheral definition and is likely to cause the inexperienced worker difficulty in focusing. It will be found that the use of high dry power is impractical with certain objects since it may be discovered that the projection of the object, as seen on the viewing glass, shows undesirable spheric aberration even though the objective is a corrected one. In the majority of such cases it will be found that the reason for this is that the draw-tube of the microscope or the thickness of the cover glass is incorrect for the particular objective used. The first difficulty is easily remedied and if the objective nosepiece is adjustable, the last difficulty can often be overcome but too great a thickness of the section will produce confusing results in a photomicrograph even though the eye discounts for slide object thickness on the viewing screen. This is due to the fact that the depth of the plane in focus at any one time decreases with an increase in objective power. By focusing up and down the observer tends to regard the screen image as tridimensional and forgets that, to the sensitive emulsion, whatever is not in absolute focus will appear diffused. Ideally the thickness of the section should be no greater than the depth of the plane of focus and while this may be impossible with homogeneous examination of microtome preparations the more nearly it is approximated the better the results attained will be. In choosing the proper objective the primary rule is to pay no attention to object size as

seen on the ground glass but only to the degree of individual detail it is desired to obtain.

There is no way to get an increase in definition and in the exposure area of the slide object at the same time with stock instruments now on the market. If both are needed multiple photomicrographs will have to be made at different powers but it will be frequently found, as mentioned above, that increased depth of the focal plane and not increase of the angle of resolution at the expense of focal depth is the desideratum. An important point may be here mentioned. Filters are most frequently used in photomicrography in order to enhance the contrast obtained in the negative and offset the polychromatic effects of the dyes used in the histologic stain but it should be remembered that since light has a wave form and since each pure color has an essentially different wave length the angle of resolution will be different with different filters even though the same objective is used. This is due to the fact that decreasing the wave length has the same effect as increasing the numerical aperture. The shorter the wave length employed the greater the degree of resolution obtained will be (the red end of the spectrum has the greatest wave length, with 750 Å units; and the violet the least, 350 Å units). The increase of resolving power obtained by the ultraviolet microscope depends upon this principle. Theoretically photomicrography in a vacuum and by gamma or X-rays would represent the ultimate in present-day photomicrographic resolution.

We now arrive at the question of bellows length. There are two practical objections and one of a theoretic nature to the indiscriminate extension of the bellows.

The intensity of light reaching the emulsion in high power work is so negligible that special actinometers must be used for its determination. As a consequence the exposure time must be correspondingly longer. When filters are used the abscissa values on the Hunter and Driffield curve are extremely long, for even moderate contrast, but since in photomicrography a high degree of gamma is desired the ordinate value must also be large in order to employ the full advantage of the right end of the film density strip. This tends to still further increase the exposure time. The use of the familiar Wratten and Wainwright "M" plate implies the employment of a very slow emulsion and consequently exposure time is still further increased. (Wratten and Wainwright "M" plates are about six times slower than Wratten and Wainwright hypersensitive plates and should not be confused with them.) Now if the bellows is extended the lumen value is still further cut down and exposure must again be lengthened. With the use of a ribbon filament lamp the number of foot candles is cut down to about one fourth by the full extension of the bellows.

(To measure with a regular Weston actinometer remove all the microscope lenses from the system.) One, however, is forced to deal with extension of the bellows on a more complex basis than simply multiplying the exposure time by two if the bellows is extended half way. The actinic value of the light reaching the emulsion is not in arithmetic inverse proportion to the bellows length but varies inversely as the square root of the distance traversed. With

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Explanation of Opposite Plate

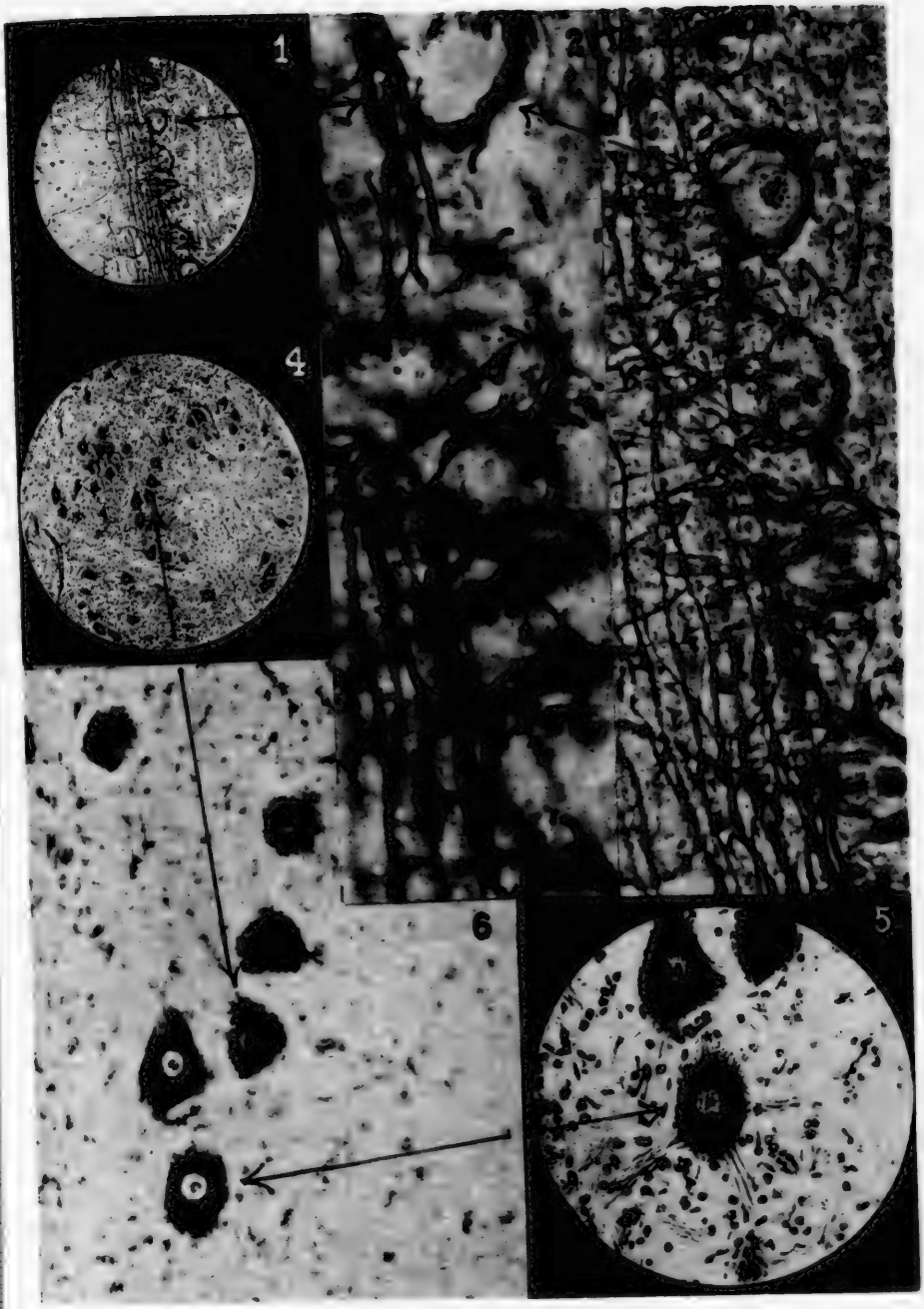
Figures 1–3.

Purkinje layer of human cerebellum. Cajal silver stain. Filter X1. These three figures illustrate that while pulling out the bellows increases the size of the negative it sacrifices the appearance of the general configuration of the object viewed. An increase in the definition of individual elements is obtained but not so good as would have been obtained by using a higher power objective. When this is impossible, due to the thickness of the section or cover glass, it may be approximated, but only approximated, by pulling out the bellows to take advantage of the closer approach permitted by the next lower objective. Fig. 1. Objective, 45X. Leitz projection ocular #2. Plate distance from ocular, 5½ inches. Exposure 1 sec. upon W & W "M" plate. Six Purkinje cells are visible. Fig. 2, optics as before except that plate was now 41½ inches from the ocular. Sixty seconds exposure. Everything beyond 4 x 5 inches on the original plate of 8 x 10 was out of focus due to the optical system. While resolution in this restricted field is excellent, the depth of focus is extremely shallow and objects at levels other than the critical focus obscure definition. Fig. 3. This is an enlargement of five times of the negative of figure 1. Notice that although the resolution of the individual elements which are in critical focus in figure 2 is now poorer, that this print gives a much better idea of the section as a whole due to greater depth of critical focus.

Figures 4–6.

The subject here is a wavy celloidin section of the ventral horn of the spinal cord. Stained by *cresyl echt violett*. Filter B. These three figures illustrate that enlargement of a low-power negative to give the same size of individual objects which is obtained by high-power work does not result in identical pictures. Fig. 4. Objective 10X. Plate 5½ inches from ocular. Two seconds exposure on W & W "M" plate. Fig. 5. Same subject but with objective 45X and ocular at 7½ inches from the plate and 10 seconds exposure. (Waviness of section and thickness of cover glass render oil immersion impossible.) Fig. 6. Enlargement of the negative of figure 4 circa X 6.3. Notice that the configuration of the features of this print is identical with that of figure 4. The fine detail of a particular focal plane obtained by the higher numerical aperture lens is entirely wanting. The enlarger cannot be expected to put something into a print which is not in the negative in the beginning.

The fuzziness seen is not the result of out-of-focus enlarging but due to waviness in the original section. Such a defect is only enhanced by enlargement of the low-power negative.



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modern equipment corrected for vibration there is not so much chance of interference with the focus by jarring the apparatus but with a long exposure, even assuming that vibration of the system does not occur, there is always a certain amount of expansion of the system under the influence of the heat of the lamp and this will throw the focus off somewhat. For a number of reasons it is desirable to use the shortest possible exposure and when this is in the nature of minutes it is a decided disadvantage to further prolong it by bellows extension.

Another practical consideration is the cost of the plates used. One or more trial exposures will always need to be made and, if the operator is inept, the price of a single good negative on a large plate will be many times that if smaller plates had been used. Practically there is rarely any necessity for increasing plate size above 4 x 5 inches. There is, moreover, an important optical objection to bellows extension. Since the back lens of the objective is curved the use of an ordinary ocular cannot project the periphery of the field in the same focus as the center and, as the bellows is extended, this lack of peripheral definition becomes more and more apparent. The only way out of a situation of this sort is to use an ocular designed for projection and corrected for the objectives used with it. The bellows length should never be extended in the hope of overcoming this difficulty since it will only render the discrepancy more apparent.

If the worker includes a negative enlarger in his equipment certain of the above difficulties may be overcome but it must be borne in mind that enlargement of the negative will not correct a poor focus any more than will extension of the bellows. Neither will it overcome loss of peripheral definition but will, like bellows extension, only render it more apparent but to a lesser degree. The important point to be borne in mind, however, is that if the negative is correctly made there will be no introduction of obscure difficulties by enlargement.

Assuming that the worker is equipped for bromide enlargement the only difference in the routine employed is that the bellows is never racked out but used at a minimum extension. The principles governing the choice of objective, oculars and the mode of adjustment of the light pencil are exactly the same as any successful worker always uses. More care must be given to obtain a critical focus than if the negative is made on a larger scale but since perfect focal adjustment is always imperative, this introduces no new nor serious handicap. Of course the usual precautions must be observed to keep the emulsion dust-free and to avoid the formation of air bells and streaking during development. With a slow emulsion, such as those usually used in photomicrography, and a fine grain developer the plates can be blown up to a size greater

than there is likely to be any need for even in wall exhibition. It is to be noted that fine grain development is likely to cause degradation of juicy blacks in the final print but there is no objection in most work to graininess in the emulsion and contrast developers can be satisfactorily employed if the negative is not to be blown up too far. The worker is cautioned against "trick" developers which are likely to be costly in time and spoiled materials. (Actual micrometric measurement incidentally rarely reveals a reduction in the size of the silver particle but rather a certain mushiness which produces a "fine-grain" effect.) The utilization of the formulae supplied by the makers of the plate which the worker uses is a wise procedure to follow for critical work until the characteristics of the particular fine grain developer chosen are known.

The employment of bromide enlargement technique then has the triple advantage of shortening negative exposure time, allowing the use of better focal penetration and cutting down plate size. For the busy worker the first advantage, aside from the benefit of lack of interference with the focus, is an important consideration and the lessened cost should appeal to any average individual.

Another important advantage of the use of enlarging techniques is the possibility of double printing and dodging. While the scientific photographer is not interested in retouching to alter the appearance of the photograph it is much easier to introduce scales, legends and guide lines by double printing during enlargement than contact printing.

It is not possible to go into the construction of the photomicrographic apparatus itself (which should have a long bellows for microtessar work) nor that of the enlarger. It will be found that the horizontal variety of enlarger is preferable to the vertical type because of the increased necessary capacity of the illuminating cage.

In conclusion it may be said that bellows extension should be left strictly alone in photomicrography except in one instance mentioned below. If an increase in size of a generalized photomicrograph is what is wanted, a small negative should be made and subsequently enlarged. Pulling out the bellows in such a case destroys general characterization, lengthens the exposure time to extreme periods and distorts the peripheral field. It does increase resolution over a limited area and in a narrowed focal plane but for such a result the worker should use a higher power objective if the slide object and cover glass are not too thick to permit it. If they are, an approximation may be obtained by using a lower objective and pulling out the bellows to accommodate the nearest possible position of this lower power objective.

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SURFACE ILLUMINATION IN LOW AND MEDIUM POWER PHOTOMICROGRAPHY*

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PART 1. WITHOUT THE USE OF A MICROSCOPE

THE photography of objects at low and medium magnifications can be usefully applied to an endless variety of material for illustrative purposes. Good results are obtained, if the simple principle of directional lighting is given a thought. With an arrangement of one or more illuminators, the photography of small objects or small areas selected from larger objects, can be accomplished with photographic objectives of short focal length, without the use of a microscope, as no eyepiece will be found necessary at magnifications under fifty diameters and the requirements do not exceed a numerical aperture of .10. The short focus anastigmats cover a comparatively large area with less curvature of field than found in microscope objectives used with an eyepiece.

The Camera and Focusing Mount

The camera should be of rigid construction and of the vertical type, and becomes necessary when liquid preparations are photographed. The camera base should be of sufficient weight to support the bar with clamping adjustments for the camera, and to hold it without vibration. I prefer the five by seven inch plate or film size. The illustrations were made from negatives of this size, small areas were selected for the cuts used.

The most convenient method of reaching the final focus, is by means of a focusing mount. Two forms are illustrated in figure 2; the rack and pinion

* Received for publication June 29, 1938.

Explanation of Preceding Plate

Fig. 1. Apparatus in position for the photography of small objects with the use of one illuminator

Fig. 2. Accessories used in the photography of small objects. Illuminator, water cell, elevating tables, objectives, protractor, focusing mounts and camera

type with cone (on table) supplied by Bausch and Lomb, and the spiral focusing mount by Zeiss (on camera). Both are efficient for this kind of work.

Optical Requirements

The number of photographic objectives required, will depend upon the scope of the work in view. They should be selected to meet the magnification and covering power wanted on the plate or film. The following have been found useful over a large range of work. They are anastigmats of the Planar, Tessar and Summar type with an aperture of F/4.5, in focal lengths of 16, 20, 24, 35, 50, 60, 64, 75, 100 and 120 millimeters. Three anastigmats of longer focal length for very low magnifications are included, a 136.5 mm. F/6.3, a 152.4 mm. F/7. and a 209.5 mm. F/6.3. Longer focal lengths could be used but the bellows extension becomes too long and unweildy.

An objective with an aperture of F/4.5 when used at full aperture, has a numerical aperture of about .10. If greatest resolution is important it should be used without stopping down. Again this may be less important than the slight increase in depth of focus gained by the use of a smaller aperture. The only way to increase resolution is by the use of still larger apertured lenses, but keeping in mind that depth of focus decreases with increasing aperture. The firm of Carl Zeiss have recently listed three objectives of larger aperture which are called Mikrotars, with the following description—

Explanation of Opposite Plate

How Modeling Is Altered, by Change in Direction of the Light

Fig. 3. Rock with fossils. X 10
Objective. Zeiss 50 mm. Planar
Eastman Commercial film
Light directed at angle across specimen from the left side

Fig. 4. As above, except the light directed from the right side

How Contrast Is Increased by Change in Angle of the Light

Fig. 5. All rag stock newsprint paper. X 30
Objective. Zeiss 20 mm. Planar
Eastman Process film
Light beam at 7 degrees to the surface of the paper
A grazing beam giving excessive contrast

Fig. 6. As above, except the light beam at 10 degrees, giving less contrast than figure 5

Fig. 7. As above, except light beam at 17 degrees. A normal lighting for material having little structural depth

5

6

Aperture	Focal length	Numerical aperture
F/1.6	1 cm.	0.31
F/2.3	1.5 cm.	0.21
F/3.2	2 cm.	0.15

Five other Mikrotars of longer focal length are listed working at apertures of F/4.5 to F/6.3. These new Mikrotars will replace the Micro Planars supplied by this firm.

Illumination

In objects having very little structural depth, such as a sheet of newspaper, a single illuminator will cover the lighting requirements. Figure 1. By changing the angle of the light beam in relation to the surface of the object, a varying amount of contrast can be built up. Figures 5, 6, 7. When the object has more depth, such as found in many textiles, one or more extra illuminators will be required to throw light into the shadows, if excessive contrast is to be avoided. Figure 9. These secondary illuminators may be of less intensity than the illuminator giving the main light beam. What is indicated by the foregoing, is simply applying studio lighting to small objects, by using more concentrated light beams, directed within a small area. Figures 3, 4, 9, 10, 11, 12, 13, 15, 16, 17, 18. Here the objective is close to the object with a considerable amount of bellows extension, while the reverse would be photography in the ordinary way.

With the main illuminator, a water cell with at least two inches of water for the light beam to pass through, materially reduces the heat otherwise produced at point of focus of the light on the object. A choice specimen may be ruined, if this precaution is not taken. The water cell shown in figures 1 and 2 is supplied by Zeiss.

The illuminator I have found most useful is one I devised years ago, figure 1. It consists of a rugged lamphouse with elevating and tilting adjustments, with an aspheric condensing lens in rack and pinion mount. The lamp is a ribbon filament of tungsten in a T20 bulb. It operates at five volts, fifty amperes, with a transformer adjustable to three steps. This lengthens the life of the lamp by bringing the current up to full load slowly. The area of illumination on the object is larger than that given by the 108 watt ribbon filament lamp generally used. The even illumination, due to freedom of coiled filament structure when at focus makes it an ideal source for surface illumination at low magnifications.

A second choice is the 500 watt projection lamp in a T10 bulb, medium

prefocus base, biplane filament, used in the lamphouse described above. It is the same bulb used in 16 millimeter motion picture projectors. The lamp needs air blast cooling and works on line voltage at full load. An adjustable rheostat can be added to control the light. When at focus on the object, the filament structure gives uneven banded lighting which is considerably reduced by having the focal point either before reaching or beyond the object, with some loss of light intensity.

The secondary illuminators are filament microscope lamps as supplied by Bausch and Lomb, Spencer, Zeiss and Leitz. The angle at which the light reaches the object is measured by means of a protractor, the one shown at base of the illuminator, figure 1 is No. 183 of the L. S. Starrett Co.

Explanation of Opposite Plate

Fig. 8. Hair on arm, half of which was removed by the use of a depilatory. X 5
Objective. 100 mm. Summar
Eastman Panchromatic Process film
One illuminator at angle

Fig. 9. Run in a silk stocking. X 7
Objective. 75 mm. Planar
Eastman Commercial film, anti halation
Shadowless background. Three illuminators used. One for main light beam on surface, the second to lighten shadows on the surface, the third to mirror and condenser beneath the object, to give an opaque background on the negative and block out the background shadows from the first and second surface illuminators

Fig. 10. Sulfide burn on skin, caused by too frequent use of a depilatory. X 11
Objective. 50 mm. Planar
Eastman Panchromatic Process film
One illuminator at angle

Fig. 11. Sharp sand dispersed on black velvet. X 8
Objective. 75 mm. Planar
Eastman Process film
One illuminator at 25 degrees to sand

Fig. 12. Drops of water on a processed water repellent silk crepe. X 4
Objective. 120 mm. Summar
Eastman commercial film
One illuminator at a low angle across fabric to a small mirror directing the light beam to the fabric and drops of water

Fig. 13. A slime mould, Perichaena Corticallis. X 6½
Objective. Bausch and Lomb 72 mm. Micro Tessar
Eastman Commercial film
One illuminator at angle to specimen

8
9
11

Object Holders and a Viewing Device

For the orientation of irregular shaped objects, an elevating table with a ball joint or socket is a great convenience, the object being held on the table top with a small piece of plasticene or other means, and the table top manipulated to bring the area selected on the object to a position of best focus when viewed on the ground glass of the camera. Two forms are shown on figure 2. The larger elevating table, at the left, has a flat top and is a plain microscope stage that rotates. The edge is graduated in degrees read on a vernier at the side. It has no tilting movement but makes a good table for flat objects. The mirror was added to produce photographs with a shadowless background on material like sheer stockings, figure 9, which if illuminated in the regular way, a background of confusing shadows would result. Beneath the stage a sliding condenser ring holds a spectacle lens condenser of similar focus to the objective in use. A parallel beam of light from an extra illuminator is reflected by the mirror to the condenser to evenly illuminate the background of the stocking, while the surface is illuminated by the main illuminator at a suitable angle. The background exposure should be just enough to give sufficient opacity in the negative to leave a white background on the print. Some form of compressor will help to bring the uneven surface of thin flexible materials into one plane, an example being a textile with loose fibers or a piece of paper with a tendency to wrinkle, on which very little pressure will be found necessary.

Figure 1 illustrates the one illuminator system for low power photography. Camera with objective in rack and pinion mount, the object in position on tilting elevating table, illuminator and water cell, with protractor showing angle of light beam. The pipe for air blast cooling the 500 watt projection bulb at foot of illuminator.

An auxiliary viewing device, that I built years ago, is shown in figure 14. It is a side reflecting viewing box that has several advantages when used with a vertical camera. First, no box or ladder is necessary to stand on when viewing the ground glass and there is less strain on the neck and eyesight, which occurs when working in the awkward position, when the ground glass lies at the top of the camera. The second advantage is the added extension to the bellows which will be found useful at times. I do not understand, why manufacturers of photomicrographic equipment have not supplied a reflector of this type as an added accessory for their cameras. The device is interchangeable on two cameras of the same type by releasing the thumb screw shown on the

black piece of bakelite on the right hand side of the camera. An extending metal hood has been added, but not shown in this illustration. The only important point in its construction, is to have the top ground glass or plate position, the same distance from the first surface mirror when in the reflecting position, the same distance to the side viewing ground glass. With the mirror in position to view the image in the side ground glass, the plate holder slide can be withdrawn, so only a short interval need elapse between viewing the image and making the exposure. This is accomplished by covering the light source beam, dropping the mirror to the vertical position close to the side viewing ground glass, and making the exposure. Returning the mirror to the reflecting position, shuts off the light reaching the plate or film. The slide may then be returned to its holder.

PART 2 of this article, will continue to deal with surface illumination in low and medium power photomicrography, but with the use of a microscope.

Explanation of Opposite Plate

Fig. 14. Side reflecting viewing box. An added accessory for use with vertical cameras. It consists of a hinged first surface mirror directing the image to a side viewing ground glass when in the 45 degree position and allowing the image to reach the top ground glass or exposure position when released

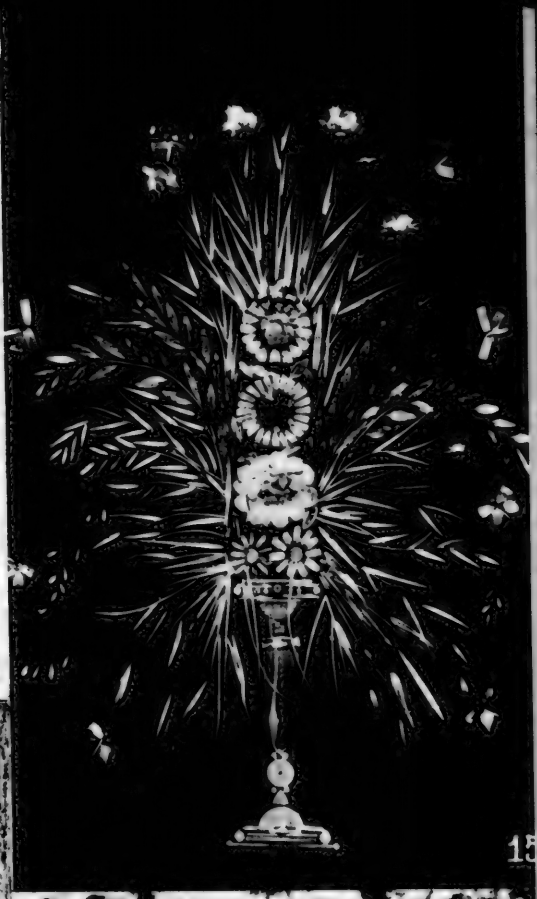
Fig. 15. Arranged butterfly scales with a few diatoms forming the base of the vase. X 14
Objective. 50 mm. Planar
Eastman Panchromatic Process film
One illuminator at angle

Fig. 16. Semibituminous coal. Polished surface. X 7
Objective. 75 mm. Planar
Eastman Commercial film
Light beam at 21 degrees

Fig. 17. Surfaced piece of coke showing porous nature. X 7
Objective. 75 mm. Planar
Eastman Commercial film
Light beam at 21 degrees

Fig. 18. Household dust, consisting principally of fibrous material. X 20
Objective. 24 mm. Micro Summar
Eastman Commercial film
One illuminator at angle

14



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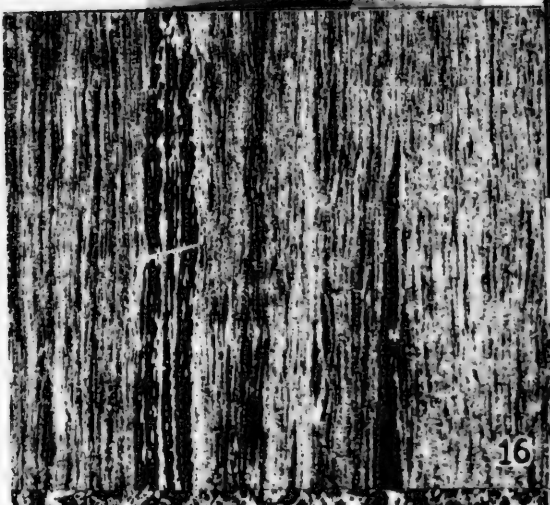

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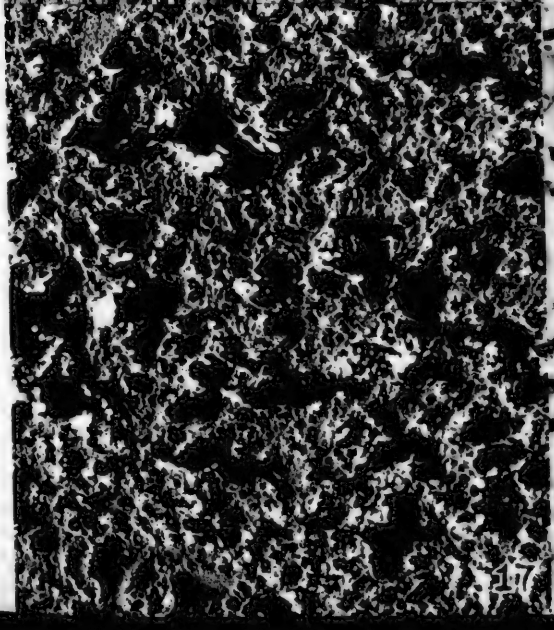

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COPY HOLDER*

ETHEL M. HART†

THE copy holder shown in the accompanying illustration has been found useful when copying from books for lantern slides and other purposes. It holds the book flat and rigid. Photographs and other flat copy may be fastened to the upright copying board with thumb tacks or push pins.

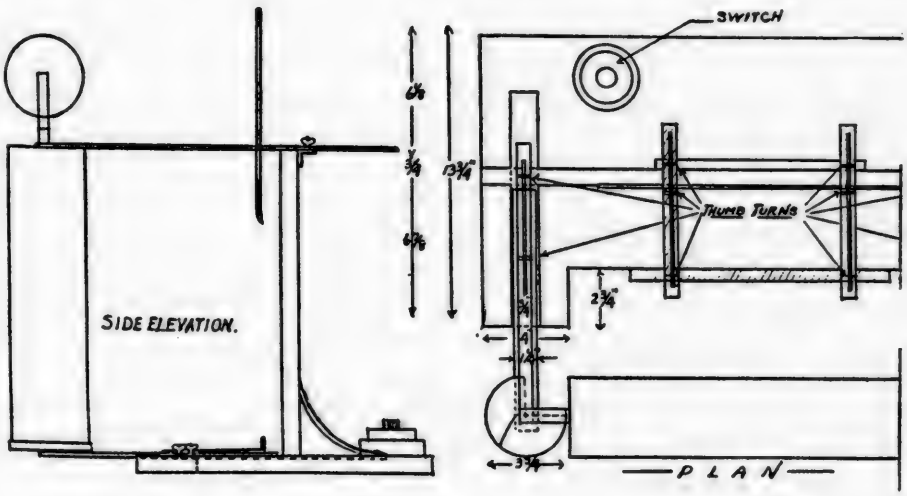
The shielded light units are adjustable as to distance from the copy. They are made of tin which reflects the light and will not warp from heat. They are on pivots and may be rotated so as to keep light from shining into the lens even when making close-ups with a short focus lens.

Each unit contains two 60 Watt Mazda bulbs. The top unit is not always needed and may to advantage be turned off when making a copy of a large subject, to insure even illumination. The lights are connected to a common switch on the back of the base board.

The upper and lower copy clamps, each having two adjusting rods, are made of aluminum and held in place by thumb turns. The top clamp is mounted on

* Received for publication June 6, 1938.

† Maternity Hospital of Cleveland (University Hospitals).



two slotted rods which permits adjustment backward and forward as well as up and down, to accommodate books of different sizes and thicknesses.

The copy board is held rigidly in perpendicular position by shelf brackets on either side, at the back.

The whole is painted a flat black except the tin on the inside of the hoods.

The illustration opposite shows a photograph of the apparatus as the lens sees it. On the preceding page is a sketch of the side elevation and one half of the plan showing dimensions. My experience indicates it might be better to make it somewhat larger.

PHOTOGRAPHIC TECHNIQUE, NEW PROCESSES, AND EQUIPMENT

F. R. HARDING

Children's Hospital, Boston, Mass.

Notes on the Processing Room

CLEANLINESS in the processing room is very essential, but it is frequently neglected. There is no reason why the room should be littered with waste and covered with spatters of developer and fixing bath. A waste-barrel should be placed close to the developing tray and the film loading bench, and all waste should be deposited in the container. If the floor of the room and the splashboard at the rear of the sink are wiped off each day, little time will be required to keep everything clean. If chemical drippings and spatters are allowed to accumulate over a long period, it will be found most difficult and occasionally impossible to remove the deposit. This is especially true of hypo drippings which harden to a stone-like consistency. In addition to the untidy appearance of a neglected processing room, there is a real danger in not properly cleaning the room. Dried chemicals powder to a fine dust and

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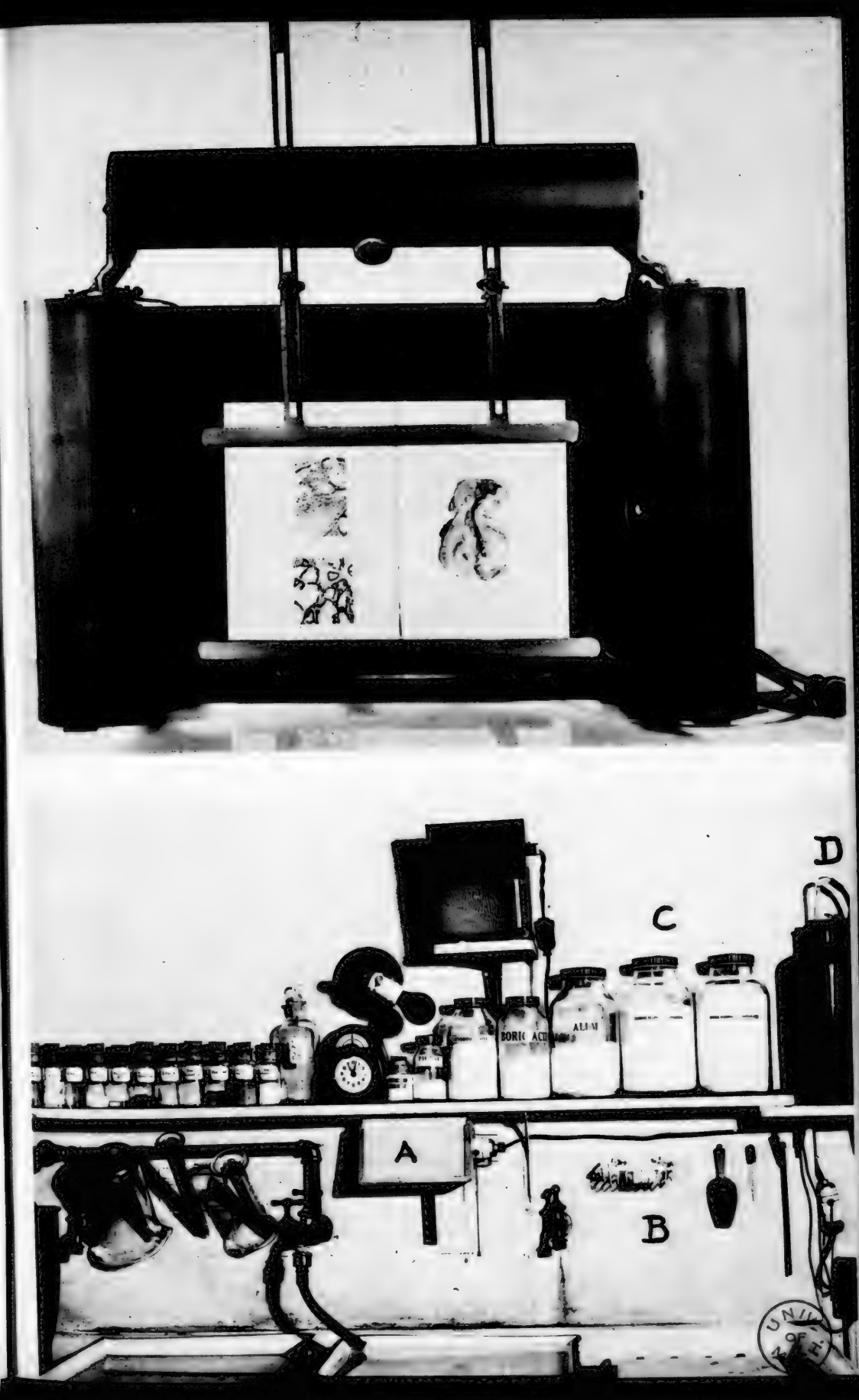
Explanation of Lower Plate Opposite

Fig. 1. The illustration shows some of the points brought out in the text.
A—White light for lantern slide examination
B—Small objects hung on the sink splashboard
C—Chemicals in transparent glass bottles
D—Developer in one gallon jar fitted with siphon


D
C
A
B

float about in the air. If these particles come to rest on sensitized paper or film, they frequently cause dark or light spots to appear. This is particularly true when the developer and fixing bath are being prepared. The shelf or bench should always be wiped with a damp cloth after the chemicals are measured and if there has been any spilled on the floor it should be mopped. Dry chemical dust settling on undeveloped film has caused many "manufacturing flaws."

Sinks should be thoroughly cleaned weekly, and the drains should be cleaned daily. The writer's preference is for white enameled sinks, as stain and dirt show readily and may be removed at once.

If possible every processing room should have a waterproof floor and a floor drain installed. This prevents damage if a sink overflows, and also allows more water to be used when the floor is washed.

A matter seldom given much consideration is the height of work benches, printing machines, etc. A little thought when the processing room is being planned or renovated will add much to the personal comfort of the workers. The film loading bench is usually employed with the operator in a standing position and its height should be such that the worker may stand erect while loading film. This also applies to many printing machines, and to all sinks. If apparatus is constructed so that the operator is in a sitting position, there should be plenty of knee room so that it will be unnecessary to lean forward during the operation of the apparatus. Individual safelights should be placed where they are most useful. In addition, an indirect safelight placed near the ceiling will produce a general illumination for the whole processing room. Lamps should be the size recommended by the manufacturer of the safelight. If stronger lamps are used, they may cause fogging of sensitive material. A rack to hold safelight glasses for various materials may be constructed and placed on the wall near the safelight most often employed. This will save time, as no searching to find the proper safelight will be necessary.

When lantern slides are made, it is frequently advisable to examine the slide under a white light after fixation. It is somewhat a nuisance to turn on the regular overhead light in order to examine the slide. A small box—about 4 x 5 inches—with a white opal glass front and an electric socket inserted through the end, containing a 15 watt lamp is of great assistance. It may be fastened to the sink splashboard at the rear of the fixing bath tray. A waterproof momentary contact switch to be operated by foot power may be connected to the light box, or a porcelain chain pull socket containing an insulating insert in the chain, may be employed. The foot switch is more convenient.

A very efficient and neat method of storing the various dry chemicals necessary for compounding developers, fixing baths, reducing solutions, intensifiers, etc., is to remove them from the original containers and place them in large mouth, screw top glass bottles, neatly labeled. In this manner, a glance shows the amount of material on hand. A duplicate supply of chemicals, unopened and left in the original container may be kept on a separate shelf. When a bottle is emptied, a new supply is taken from this stock and placed in the glass bottle. The edge of the shelf containing the duplicate material may be labeled with the name of the material to occupy the space. When an order is made out it is only necessary to observe the blank spaces and read the labels on the edge of the shelf.

The walls of many processing rooms are painted black. This is unnecessary, and creates a gloomy atmosphere in which to work. The writer has employed buff colored processing room walls for many years and has found that it works well and is much more cheerful.

Many processing rooms are so small that it is not possible to do work in an efficient manner. On the other hand, a dark room which is too large is also inefficient because of the added steps necessary in passing from developing sink to printing machine, etc. However, when the processing room is being designed, provision for future expansion should be made so that additional apparatus may be installed without enlarging the room.

If the department is operated by one individual, much time may be saved by having a telephone jack and ringing box installed so that the instrument may be used either in the processing room or the office. This change is not expensive and it is a great convenience.

The ventilation of many processing rooms is not good. Complete air conditioning is of course the ideal method, but unfortunately it is seldom available to the institutional photographer. There are several methods of keeping the air in motion. An electric fan placed on the floor under a bench will create a circulation, but it will not cool the air. One of the large manufacturers of photographic materials has a fan ventilating system completely equipped with light baffles which is not expensive and is very efficient. One or two outside windows in the room, covered with movable, light tight curtains is of great assistance in keeping the air fresh. When the room is not being employed, the curtains are raised and the windows are opened. There are several methods by which the windows may be made light tight. One of the most simple and successful ways is to employ a double thickness of black shade material, each piece being painted black to render it opaque. After the painting has been completed the two pieces are sewed together. Place the double thickness

of the shade on a spring roller and build a four-sided double frame into the window casing. The two frames are separated by about ¼ of an inch, forming a groove in which the shade travels. The cord travels through a pulley fastened to the window sill and is led through a small hole at the inside bottom frame. The frame is approximately six inches in width. Properly constructed, these frames will render a room absolutely light tight. Another method is to make a large composition board screen fastened to a wooden frame. Place felt weather stripping around all sides of the window casing and hinge the screen to the casing. The felt acts as a light tight gasket. One disadvantage of this method is that no tall apparatus may be placed near the window, as the screen swings into the room when it is opened.

Whenever possible the entrance to the processing room should be in the form of a maze. While it occupies slightly more space than single or double doors, the added ventilation and ease of ingress when the operator's hands are full more than offsets the lost space. An efficient maze may be constructed in a space of 4 x 5 feet. The width of the passage in a maze of this size should not exceed 20 inches, and the two parallel walls may be 3 feet in length. This maze is smaller than those generally described but it is a proven success.

For efficient operation the printing, enlarging, and reducing apparatus should be grouped in close proximity to the developing and fixing trays. Many extra steps are saved when this is done. If it is not possible to group all the printing and enlarging apparatus near the trays, place the most used machine, usually the contact printing apparatus, nearest the developer.

Sponge rubber rugs or wooden gratings should be placed in front of the sink, so that the operator will not stand on damp flooring.

There should be a number of electric outlets installed, more than the needs of the moment may call for. A use will be found for all of them eventually, and it will save employing double plugs and long extension cords. These outlets should be installed about 3½ feet from the floor. This is a protection against water and they are also more readily used at this height.

If a fan is employed for drying purposes, it should be turned on one or two minutes before the material to be dried is placed in the air stream. By doing this any lint or dirt on the floor or bench is blown away and does not imbed itself in the emulsion.

Small objects such as stirring rods, chemical scoops, droppers, and thermometers may be hung on small brass hooks. These are placed on the sink splashboard. Cotton for wiping film and prints may be kept in a soap dish placed so that it will drain into the sink.

Eastman Announces New Three-Intensity X-ray Illuminator

Physicians and x-ray workers (radiographic laboratories) will welcome a new three-intensity Eastman X-ray Illuminator just announced from Rochester by the Eastman Kodak Company.

A regulating switch on the 14 x 17 illuminator provides instant choice of any of three light intensities. This feature allows the user to vary illumination according to the density of each radiograph, and select the light range which best accentuates diagnostic detail.

Illumination is evenly diffused, and approximates north daylight. The viewing area has rounded corners to conform to the rounded corners of radiographs, and the angle can be varied by an adjustment on the rear support of the illuminator. The illuminator is fitted with blue-tinted, flashed opal glass which is kept cool by a clear glass baffle a few inches in front of the bulb. It is designed for either a 200-watt daylight blue frosted Mazda bulb, the special 250-watt Westinghouse x-ray illuminator bulb, or a No. 1 Photoflood lamp.

Four spring-clip fingers, uniquely designed, securely hold dry radiographs. Two convenient arms are provided to hold wet radiographs in hangers a few inches away from the illuminator frame to protect it against moisture. Construction is all-metal and exceptionally durable, with a finish of rich-grained walnut. The illuminator rests on three feet which will not scratch polished surfaces; one foot is sponge-rubber to prevent skidding.

Several improvements of the new 14 x 17 Eastman Illuminator have been incorporated in the new 8 x 10 Eastman Illuminator, also just recently announced—notably the convenient new-type clips, all-metal construction, grained-walnut finish, and switch on the front.

An 8 mm. Titler by Bell & Howell

The new B & H 8 mm. titler consists of a base and camera stand cast of aluminum in one piece, and an illumination arm which fastens securely to the camera support and bears two mazda lamps. At the upper end of the camera stand is a special, highly-corrected copying lens in the well-known Film snap-on-mount, to which the camera is fastened in the usual way after the regular photographic lens has been removed. The titler lens is accurately pre-focused on the title card holder on the base, directly beneath the camera.

The holder takes title cards 3¼ x 2¾ inches, which size was selected as being the best for reproducing typewritten titles so that they appear entirely

legible on the screen. Snapshots, magazine cut-outs, and other suitable backgrounds are readily available in this size.

The illumination arm fits firmly in its socket on the camera stand, and the two lamps and reflectors are permanently fixed in the exact position which eliminates any possible glare from the surface of the title card. It is even possible to use a glossy finished photograph as a background, without recording highlights in the title. Two sets of lamps are furnished with the titler, providing correct illumination for films of various emulsion speeds. Panchromatic reversal and Type A Kodachrome films call for the 75-watt lamps, while positive film and regular Kodachrome plus the blue filter require the 100-watt lamps.

Since the newer Filmo 8's are all equipped with the single exposure device, the titler is actually a most efficient miniature animation stand. Animated maps, drawings, cartoons, etc., are all easily made.

The titler can be used in a horizontal position, with the camera resting on its own base, and since the titler lens has the remarkable depth of field of more than one inch, objects of considerable depth may be photographed in sharp focus. Insects, flowers, butterflies, etc., will show up beautifully in color as well as in black-and-white.

ADAPTATION OF A TELEPHOTO MOTION PICTURE CAMERA TO FIELD USE*

CHARLES S. APGAR, JR.

FOR some years there has been felt a need for a portable motion picture camera especially equipped for moderately high power telephotography. With the view of meeting, to a certain extent, this objective the instrument herein described was assembled.

The instrument, to meet these demands, must be light enough to be carried over long distances fully assembled and yet should be so constructed that taking it down could be easily and quickly accomplished in order that the camera could be used with its shorter focus lenses. Its size should not be too unwieldy to permit passage through the average second growth woods and yet it should be rugged enough to stand moderate abuse in woods travel away from trails. Lightness being one objective of construction a tripod was dispensed with, other means being devised to support the camera while in use. Likewise cer-

* From the Division of Education, Pennsylvania Board of Game Commissioners, Harrisburg, Pa.

tain refinements were necessary in order that the recorded picture be as accurate as possible.

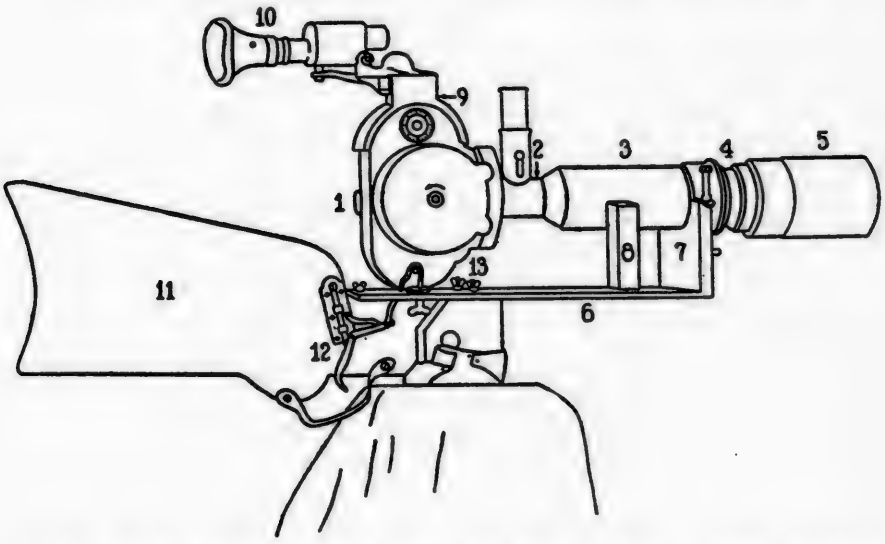
The camera used was a 35 mm. Eyemo, model 71 A, which was equipped with a 17 inch F 5.5 Dallmeyer telephoto lens, in the tube of which was incorporated a Goerz prism box or focusing magnifier. This lens and prism box unit was fitted into the regular bayonet receptacle of the camera. The camera and lens assembly was mounted together upon a rugged base of aluminum plate, the camera being held in place by a single thumb screw through the plate and into the tripod socket of the camera. The lens was supported in a socket in the upright at the outer end of the base plate and was held firmly in the socket by a copper band locked down by a knurled thumb screw. This socket and retaining strap were padded with hard felt. After finding the center of balance for the entire assembly the base plate was fitted at this center with two bronze inserts threaded for the professional and amateur tripod screws.

Beneath the camera and extending to the rear was constructed a false stock of card-board in order that the dimensions exactly suit the user. When the right size of stock was determined it was finally made of two inch white pine plank with blocks of two by four inch wood attached at the forward end to give the utmost rigidity. The stock was attached to the base plate of the camera and lens assembly by three carriage bolts and wing nuts.

The instrument was next provided with a trigger mechanism for actuating the motor release button which was hidden between the camera and the base plate. By drilling a hole through the base plate and then having a link of heavy wire hooked at one end so as to fit over the camera release pin and attached at the other end to the trigger, a means was provided for operating the camera release. A strong spring held the trigger in the neutral position and a lock consisting of a cabinet bolt which could be slid down so as to inhibit the travel of the trigger completed the essential features of the assembly.

It was found that the usual arrangement for winding up the spring motor of the camera by means of a small key was inadequate, so a six inch crank was made for this purpose. This means of cranking the motor was found to be very successful. A place was provided on the top of the stock for holding this crank when not in use, by drilling a hole just large enough to take the handle of the crank.

The finder tube supplied with the 17 inch lens proved to be very inadequate as it reduced the field of view to the limits covered by the lens. To offset this objectionable feature an obsolete telescopic gun sight of prismatic construction



1 Eyemo camera, 2 prism box, 3 lens tube, 4 telephoto lens 17 in. focus, 5 lens hood, 6 base plate, 7 upright support, 8 forward hand hold, 9 cast bronze yoke, 10 telescope gun sight, 11 stock, 12 trigger mechanism and safety lock, 13 thumb screws holding base plate to stock

was used. It was light in weight, easily attached or removed and magnified six diameters, equivalent to the power of the 17 inch lens. (This sight was formerly manufactured by the Warner and Swasey Co. and is known by that name.) The sight was attached to the top of the camera by having a special bronze saddle cast to fit snugly on the top film chamber. The sight was attached to the upright of the saddle by means of the dovetail block provided with the sight.

After assembling the camera, the finder was coordinated with the camera lens by working at night with a single electric light at a fixed location and with a piece of ground celluloid in the gate. Starting at the minimum focal distance of 8 yards the light was brought to a sharp focus on the celluloid in the center of the gate and the same light was also centered on the cross hairs in the graticule of the sight. After several readings were made for each focal distance, the final result was a parallax adjustment scale for setting the finder coordinate with the lens. In the process of finding the correct readings for setting the finder sight the prism box was used to check the readings. As the supporting saddle for the finder sight was constructed so that the sight was

exactly in line with the camera lens, no lateral adjustment was necessary so the windage adjustment of the sight was sealed with adhesive tape.

To place the camera in operation: support the camera on a stump, limb or rock with the lens opened to its widest aperture and the prism dropped into the optical axis of the prism box. A critical focus on the object to be photographed is obtained by rotating the focusing lever of the lens, then the prism is raised out of the optical axis into its focusing tube. The lens focus is read directly from its scale and the finder sight adjusted to conform to this distance by reference to a scale engraved on the lens tube. The lens is then stopped down for optimum operation, the motor wound and the camera is ready for use.

EDITORIAL CORRESPONDENCE

St. Francis Hospital
Evaline cor. Falcon Ave.
Hamtramck, Mich.
May 15, 1938

Dear Mr. Schmidt:

May I express my sincere appreciation for your cooperation in making our Hospital Day as perfect a success as it was. We at the St. Francis Hospital did not know how to evaluate the splendid collection of clinical photographs that you sent us. They have been seen by at least three or four thousand people. This included medical and pre-medical students from Wayne University and University of Detroit, school instructors, many doctors in the Detroit area, students, and amateur photographers. This fine collection was supplemented by our small number of photos and a one-reel movie on "Acute Appendicitis." Thus, thanks to you, our program was acclaimed by the Eastman Kodak medical demonstrator as better than presented in any other hospital in Detroit and vicinity.

Yours truly,
Steve Blazewicz.

Hutchinson, Kansas
April 27, 1938.

Dear Mr. Schmidt:

Thank you very much for the prints you sent us for display at the meeting of the Kansas Society of X-ray Technicians at Wichita, April 23. They were put on display and caused much favorable comment.

Yours very truly,
Esther Hulpieu, R.T.
Grace Hospital

ASSOCIATION NEWS

Photography at the Convention of the A.M.A.

Report of Mr. Ralph P. Creer of his visit to the Convention of the A.M.A. in San Francisco and his photographic impressions. Excerpts from his letter to the Secretary.

IN general I was very favorably impressed with the interest shown in photography at this convention. One evidence of this is that for the first time in the history of the Association one of their Sections invited a biological photographer to present a paper. The title of this paper was "The Relation of Photography to Medicine." Furthermore of the one hundred and fifty-five scientific exhibits, there were eight which dealt directly with the technique of photography in its relation to medicine. The large majority of the scientific exhibits used photography in one form or another and many of the commercial booths used motion pictures as an aid in presenting the merits of their products. In this connection I am glad to be able to state that of all the booths which I visited, the best-colored motion pictures there presented were the work of Mr. Leonard Julin of the Mayo Clinic, one of our original members and an officer or director of this Association.

The following is a list of the photographic exhibits which were included in the Scientific Section:

Julian M. Bruner, Des Moines, and L. E. Rosebrook, Ames, Iowa:
Photographic Records of the Cervix Uteri:
Exhibit demonstrating a method of making photographic records of the cervix uteri. Photographs illustrating lesions of the cervix; special speculum required for this work illustrated by drawings; method described in detail whereby the gynecologist can make photographic records of the cervix in the office.

Charles Edwin Galloway and Tom D. Paul, Evanston, Ill.:
The Cervix and Colored Photomicrography:
Exhibit demonstrating the use of colored photographs for teaching purposes as well as for records; the camera; a model of the female pelvis and black speculum in place; shadow boxes with colored slides; projector with a small screen.

William Stevenson and B. S. Kline, Mount Sinai Hospital, Cleveland:

Exact Photographic Medical Illustration:

Exhibit of prints with colors of original photographed specimens including gross clinical and gross and microscopic pathologic specimens exactly reproduced; color prints and color transparencies; steps in the preparation of the exact color prints, and color transparencies of gross and microscopic specimens and of color prints.

Harry C. Schmeisser and Joseph L. Scianni, University of Tennessee, Memphis:

History of Medical Art:

Exhibit of photographs showing ancient, medieval, modern and contemporary medical art.

Lewis Waters, Department of Medical Art, Baylor University College of Medicine, Dallas, Texas:

Art and Photography as Applied to Medical Illustration:

Exhibit of drawings, photographs and transilluminated pictures in black and white and in color, illustrating methods of medical illustration including methods of making motion pictures; presentation of a new color process for photomicrography and clinical photography.

This exhibit by Waters was very well thought out and very well presented.

Samuel Ayres, Jr., and Nelson Paul Anderson, College of Medical Evangelists, Los Angeles:

Natural Color Photography in the Teaching of Dermatology:

Exhibit of lantern slides illustrating various disorders of the skin showing recent development of improved color film to photograph cutaneous lesions in their natural color. Demonstration of apparatus and technique employed.

This exhibit was presented by a doctor whose sole purpose it was to demonstrate the value of natural color photography in the teaching of dermatology. Dr. Ayres also pointed out how easy it is to take kodachrome pictures with a very simplified technique consisting of a Leica camera and two 500 W lights.

Malcolm R. Hill, Los Angeles:

History of Illustration in Proctology:

Exhibit consisting of reproductions and drawings depicting the progress

medical science has made in dealing with disease as related to proctology; the relative progress made in the art of illustration.

Felix Cunha, San Francisco:

Intragastric Photography and Its Clinical Application; Use of the Flexible Gastroscope in the Diagnosis of Gastric Lesions:

Exhibit demonstrating camera used; actual method of taking snapshot and method of supplying current; cameras outlining principles maintained in construction and the principles of physics or optics involved in taking a photograph; source of generation of power for the lighting up of the stomach used in taking the photograph; gastroscope with charts showing the principle of physics involved, construction, and artists' drawings outlining various pathologic conditions encountered and easily differentiated; a motion picture demonstrating the entire technique of flexible gastroscopy.

It was my impression that the photographs which were used in the scientific exhibits were generally of a good standard, but the lantern slides illustrating the lectures were below par. Many charts could not be read at a distance, and in some instances the lecturers apologized to the audience because the slide did not demonstrate their point.

The New Bruner Speculum

A folder has come from the V. Mueller Co. of Chicago, describing the new Bruner speculum for photography or cauterization of the cervix uteri. Many members will remember the cervix pictures contributed to our Salons by Dr. Bruner, and also his article on cervix photography in the B.P.A. Journal for September, 1936. Doubtless the pictures in his exhibit at the A.M.A., mentioned above, were made with this accessory.

His speculum, now on the market, is especially designed to facilitate photographic records of the cervix before and after treatment. It carries a special light which can be slipped on to the edge of the speculum and rotated to determine the optimum angle of illumination. The light bulbs are radio dial bulbs and can be replaced at any radio supply store. Both black-and-white and color photographs can be obtained with the aid of this instrument. Further information can be obtained from Dr. J. M. Bruner, Bankers' Trust Building, Des Moines, Iowa; or from the manufacturers, V. Mueller & Co., Ogden Ave. and Van Buren St., Chicago, Ill.

It was with deep regret that we learned of the death of Professor A. C. LaTouche in Los Angeles last spring. Dr. LaTouche was one of our Charter Members and had maintained a continuous membership during our eight years of existence. He was Professor of Histology at the University of Southern California, and his main photographic interest was photomicrography, both motion pictures and stills. We heard of his death from Mrs. LaTouche to whom we offer our sincerest sympathy.

A letter from Miss Gertraud Feibelmann, Zurich, Switzerland, states that she is planning to attend the Philadelphia Convention. If she does, and we hope she will, she will break the long distance record for attendance previously held by Dr. S. A. Crooks of Loma Linda, Cal. Miss Feibelmann has been studying photography under Professor Ernst Rust at the Photographisches Institut der Eidgenossichen Technischen Hochschule in Zurich. She joined the B.P.A. in 1937. We will look forward to meeting her in Philadelphia.

Technigraphic Institute, Inc.

On brand new stationery headed "Technigraphic Institute, Inc.," Mr. W. R. Williamson, B.P.A., wrote us a letter from Chicago opening on the following intriguing note: "Within the next couple of weeks we are opening the most stupendous, gigantic, colossal, and magnificent scientific photographic establishment the world has ever known." So far we have had no follow-up from Mr. Williamson, but Mr. Creer sent us a copy of an advertisement, less exuberant but still impressive, which appeared in the July issue of the *Chicago Medical Bulletin*. Technigraphic Institute announced the opening July 12, 1938 of "the largest and most completely equipped institution of its kind—devoted to medical photography and illustration, the production of medical lantern slides, slide films, motion pictures, educational exhibits, models, moulage reproductions, and related essentials to modern practice and teaching." This Institute sounds well worthwhile and we wish it every success. It is situated at 30 North Michigan Avenue, Chicago.

Boston Chapter, June Meeting

The meeting was held at the Massachusetts General Hospital, where Mr. Wibour Lown was exhibiting the B.P.A. Travelling Salon. Mr. R. W. St. Clair spoke on "Illuminating Systems for Macrophotography and Photomicrography." After this presentation the following officers were elected for the coming year:

President	C. T. Brues
Vice-President	R. W. St. Clair
Secretary-Treasurer	L. B. Brown
Executive Committee	F. R. Harding E. P. Oxnard A. J. Iorio
Auditing Committee	Miss Mary Livingston A. W. Anthony

With the season's business concluded, the meeting was adjourned until September 9th.

Philadelphia Chapter, June Meeting

This Chapter has a friendly custom of preceding their meetings with a Dutch-treat dinner for all who care to come. The members then adjourn to the Temple University Photographic Department for their sessions. Mr. Schmidt and Miss Shiras attended the June meeting and enjoyed meeting the Philadelphia members and joining in the discussion of Convention plans. Dr. Dillman, Chairman of the Chapter, motored them to the meeting and en route pointed out the City Hall which is being renovated and is covered from top to bottom with scaffolding, masons and painters. "Getting it ready for our Convention," said Chairman Dillman.

Vote of Thanks

The B.P.A. wishes to express its sincere thanks to its group of members who are renewing as Sustaining Members. To date these Sustaining Members for 1938–39 are:

Mr. John F. Brooks, E. Leitz Co., New York City.
The Fleischmann Laboratories, New York City.
Mr. Louis Schmidt, Rockefeller Institute, New York City.
Dr. George H. Semken, 16 West 85th St., New York, N. Y.
Miss Anne Shiras, University of Pittsburgh, Pittsburgh, Pa.
Mr. H. W. Zieler, E. Leitz Co., New York City.

New Members

We welcome to the Association the following new members, and hope we will meet many of them at the convention this Fall:

Dr. Alfred E. Banks, Electric Building, San Diego, Cal.
Mr. Steve Blazewicz, St. Francis Hospital, Hamtramck, Mich.
Mr. Jerome C. Diebold, 424 Lorch St., Madison, Wis.
Miss Jean Durfee, 10530 South Hamilton Ave., Chicago, Ill.
Mr. Allen Hancock, 211 W. Linton St., Philadelphia, Pa.
Mr. J. G. Howard, University of Otago, Dunedin, New Zealand.
Dr. J. W. McCutcheon, 490 York St., Hamilton, Canada.
Dr. Fred A. Mettler, Medical College, Augusta, Ga.
Mr. William Pera, 426 Bay Ridge Ave., Brooklyn, N. Y.
Mr. Joseph Poppel, Jefferson Medical College, Philadelphia, Pa.
Dr. Irving Puntenney, Department of Ophthalmology, Northwestern University Medical School, Chicago, Ill.
Mrs. Marjorie Reese-Smith, Pepperell Manufacturing Co., Lindale, Ga.
Mr. George L. Royer, Calco Chemical Co., Bound Brook, N. J.
Mr. Albert Sadler, St. Vincent's Hospital, New York City.
Mr. Herbert S. Warren, Hahnemann Medical College, Philadelphia, Pa.

Anne Shiras,
University Office, Magee Hospital,
Pittsburgh, Pa.

The Journal of the
Biological Photographic Association

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BIOLOGICAL PHOTOGRAPHY IN ANTARCTICA

EARLE BRYANT PERKINS*

WHEN the Byrd Antarctic Expedition II left five years ago for extensive explorations and scientific investigations in the Ross Sea Dependency and Marie Byrd Land, the Biological Staff had outlined a rather elaborate program. This included work on bacteria, plankton, such invertebrates as were likely to be met with, the relatively few fishes, and the penguins and seals which are so typically Antarctic. Further, a collection of algae, lichens, mosses, and microscopic life in the fresh water pools was to be made by the sledging parties going to the mountains, and the skins of birds and seals procured for study and museum display. It was my desire, as zoologist of the expedition, to study the living animal life in its natural environment, and to bring back as a permanent record both stills and motion pictures of these animals which are so little known and so seldom seen. The photographic record of the living forms, or of freshly collected specimens, seemed to me then—as now—a necessary as well as important adjunct to the preserved material and books of field notes.

In view of the many difficulties which were encountered in a region so remote, and where unfavorable weather conditions and environmental handicaps greatly impeded activities, it is noteworthy that much of the original program was carried out. The Antarctic is not rich in living things; it does not present the great wealth of life that we find in the tropics, nor even the va-

* Received for publication October 20, 1938. Department of Biophotography, Rutgers University, New Brunswick, New Jersey.

riety of animals and plants that are seen in the Arctic regions. But such organisms as are found there are of exceptional interest because of their remoteness and their ability to survive the most unfavorable climate in the world.

On exposed mountain sides low forms of animal and plant life are found during the short period when the sun is warm enough to melt the snow and form pools in the rocks. Green algae and microscopic animal life thrive, and lichens cling tenaciously to rugged mountain sides for a brief moment before the lowering temperatures force these organisms to become dormant for eleven months of the year. On the coast where there is the moderating influence of the sea, rookeries of penguins, gulls, and petrels have been found; seals crawl up onto the ice to bear and rear their young.

In the water itself, however, we have a very different picture. Here there are probably more individual living things than at any other place in the world. All one needs is a dredge, a silk net, and a microscope to realize the astounding abundance and variety of animal and plant life. Diatoms are the most abundant—a single haul of the net brings up a concentrated mass of them having the consistency of soup and representing a score of species. Pack ice and the water line of bergs and ice islands are conspicuously stained a yellowish-green by the countless numbers of these unicellular plants. They are the primary food source for all the living matter in the sea because they are the only organisms which can manufacture their own food from the vitalizing sun, and are not dependent upon other organisms for their food.

As the winter night approaches there is insufficient light for them to carry on their activities and they disappear. But the animal life continues, subsisting upon the remains of the algae, and upon each other.

In the frigid depths of the Antarctic waters, under the heavy ice, and in the darkness of the winter period, vast numbers of animals swim, feed, cling to the bottom, and wait for the return of the sun. We wonder how they do it, but actually, except for the nearly complete absence of light in the upper regions of the water their environment has not changed since the blazing sun drove millions of tons of ice out into the sea. The water temperature remains close to the freezing point throughout the year. The invertebrates are living on others of their kind; the fishes are eating the crustaceans; the seals, as long as they can find a place to breathe, are living on the fishes and crustaceans, dependent upon the return of the sun—and the diatoms.

Soon after leaving Panama, collections were made of such plankton as could be obtained with the ship in motion. This was continued to Easter Island, and then followed a great circle course to Wellington, N. Z., over a route infre-

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quently traveled. From there collections were made southward across the Antarctic Circle, into the pack ice, and uncharted waters where no ship had been before. After cutting across this previously unexplored area we finally landed at Little America, at the southern end of the Bay of Whales. The return passage fourteen months later followed a different course, being far south of our previous crossing of the Pacific. Throughout the entire voyage plankton was collected and photographed immediately aboard ship, using conventional photomicrographic apparatus. All film was developed immediately so that retakes could be made if necessary. No unusual problems were encountered on shipboard except the heavy rolling, which made it necessary to fasten everything securely.

On the ice, however, myriads of problems arose. Outstanding, of course, was the intense, biting cold. At Little America a laboratory was erected for the entire scientific staff that was undoubtedly the best equipped of any that has been established in the polar regions. Within it, conditions approximated those we have back home, and photographic work was relatively easy except for the want of adequate amounts of water for washing film. Suitable temperature was maintained by means of coal burning stoves. Snow was melted for wash water. During the winter night every room was a dark room when the lights were out—day or night. But outside, the extremely low temperatures made photography a trying ordeal, with experience, resulting from trial and error methods, the main factor in obtaining pictures.

Successful photographs were made through a temperature range from 20 to 70 degrees below zero. The small still camera was always carried in a shirt pocket where it was kept warm enough to operate. A few pictures at a time could be taken without difficulty, but after several minutes, when it was colder than 20 degrees below zero, the focal plane shutter would drag, and overexposure would result. Oil in the camera congealed to the point where it was practically impossible to roll the film to the next frame. Men with inexpensive cameras having loosely fitted parts had no trouble, but we who had precision instruments were constantly nursing them along to get any results at all.

The motion picture camera had to be forced by the hand crank, at 20 degrees below zero or under, with consequent jumpy action. Chemical heat pads wrapped around the camera helped somewhat, until they too were frozen. Some of the most successful motion pictures were taken this way, by the light of magnesium flares during the winter night in the pressure ice ridges, with the temperature at 65 degrees below zero. The news reel cameras were con-

stantly jamming, and the 35 mm. film was as brittle as glass. No such trouble was experienced with the 16 mm. cameras, however. After all oil had been removed by washing the mechanism in gasoline and ether, there was a great deal of improvement in operation. Care had to be taken that moisture from the breath did not get on the lenses while they were being adjusted, as it would freeze immediately and cause fogged pictures. In addition to this difficulty, there was the added problem of working with heavy mittens or frozen fingers.

When seals became scarce as the days grew colder, and we needed many more for dog food, I went aloft in the autogiro to locate herds that might be within sledging distance of camp. This afforded a splendid opportunity to get motion pictures, but I did not reckon with the awkwardness of the diminutive cockpit, and the unresponsiveness of a frozen camera and frozen fingers. It was impossible to get the proper camera angle by shooting through the window, so I hung out of the cockpit, bracing myself with knees and elbows in the face of a hundred mile wind at 40 degrees below zero, holding the camera with one hand and forcing the mechanism by hand cranking with the other. At the end of the ordeal fingers were frozen a yellow-white, and nose and cheeks as well. But those discomforts passed and I have the pictures to help recall the first Antarctic seal hunt by air.

On the surface, it was much easier to record the life history of the Weddell seal. Motion pictures and stills were made of this animal from the birth of the young through the time when they enter the water for their first swim.

Judging exposure time was extremely difficult due to the blinding glare from the snow. Our photo-electric light meters failed us completely, not because of the cold as has been reported, but because of the intense light reflected from the countless numbers of snow crystals which acted like so many mirrors in the sun, giving an erroneous reading. By using neutral filters over the meter, a scale reading could be obtained, but it was untrustworthy and we invariably *under*exposed. The meter would frequently indicate as many as four stops smaller than we should have used. Exposure tests on short strips of film finally solved the problem.

With our electric generators and photoflood lights it was a relatively simple matter to take pictures indoors. Cinemicrographs were also made without a great deal of difficulty. Plankton from the Bay of Whales, and microorganisms which had been collected only 200 miles from the South Pole, were photographed through the microscope with the cine camera. By means of a stand and adapter for the microscope, made with the aid of the carpenter and the machinist, I was able to make the first motion pictures of the most southern

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forms of animal life: minute crustaceans, rotifers, tardigrades, and other microscopic organisms. Without the usual equipment for photomicrography with the cine camera this was accomplished only after much trial and error. The final set-up which produced results consisted of a vertical stand placed over the binocular microscope, the camera counter-weighted and fitted to one eyepiece by means of a light tight collar, and the other eyepiece used for focusing and viewing while the picture was being taken. The light source was a platinum ribbon filament lamp mounted behind a condenser lens, water cell, and color filter. Test strips were developed immediately so that corrections could be made while the animals were still alive. The micro-motion-pictures so obtained have an important place in the record of Antarctic life.

In the brilliant Antarctic sunshine with no color to relieve the monotony of the dazzling snow, fast panchromatic films were neither necessary nor desirable. A good ortho film or a contrast pan worked best, and in conjunction with a Wratten G or 25A filter produced detail that could not be seen with the eyes because of the blinding glare. I have been surprised recently to make prints of some of the shots that showed details not noticed when the pictures were taken.

Only film for the still camera and test strips of motion picture film were developed in the Antarctic laboratory. All motion picture stock was brought back under refrigeration and developed immediately upon our return. Some of this material was then over two years old, but seemed to have suffered no loss of speed nor acquired chemical fog.

At Little America we used films, plates, and paper left by the first Byrd Expedition five years before. The intense cold apparently had not retarded any action upon the emulsions. Since my return I have continued to use negative stock which has been kept in the refrigerator since leaving Little America. This film was manufactured in the summer of 1933 and as far as I can tell is as good as new.

*

Some developing tanks for roll films are difficult to load after the first film is passed through, due to moisture collected in the reel. This may be overcome by first wiping dry on a towel and then removing the water trapped in the grooves by immersion in 95 per cent alcohol. Dip once and shake off, then repeat and place before a fan. It dries in about two minutes.

WM. L. M. MARTINSEN.

A SIMPLE PHOTOELECTRIC EXPOSURE METER FOR USE IN PHOTOMICROGRAPHY

WILTON R. EARLE*

IN the study of tissue cultures in this laboratory it has been found necessary to rely to a great extent on photomicrographic records. For a number of years, however, a lack of facilities for maintaining accurate control of the exposure time in the photography of the cultures very greatly reduced the value of some of these records and caused the loss of others. On account of the extremely unsatisfactory and unreliable results obtained by older methods of determination of the correct exposure time, a photoelectric exposure meter finally was devised which in simplicity of construction and operation, and in the accuracy of its results, has given quite reliable and satisfactory service during the four or five years it has been in use. This meter has seemed of such general applicability in laboratories doing routine photomicrography, particularly routine photomicrography of living cells, that a description of the apparatus and method are given herein.

Design and Construction of the Equipment

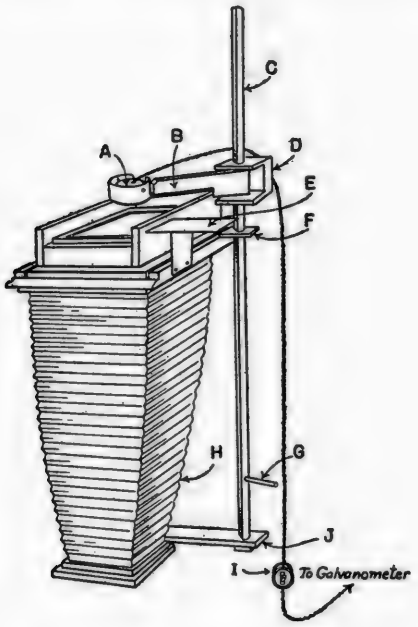
The assembly herein described is used with a vertical photomicrographic camera for the photography of tissue cultures and stained tissue preparations. The equipment is designed to allow for its control from near the lower end of the camera. Individual modifications to adapt the equipment to other specific photographic problems will suggest themselves readily.

The equipment consists essentially of a photoelectric cell, a sensitive reflecting galvanometer, a light source in a housing with condensing lens, and a scale for reading the deflection of the galvanometer. The photoelectric cell of the equipment is mounted directly on the camera so that it swings out over the ground glass and records directly the intensity of light striking the ground glass itself. This is done in order to eliminate corrections for the diameter of the circles of light coming from the ocular and for the bellows extension of the camera.

This photoelectric cell is of the Weston Photronic type and is inexpensive

* Received for publication August 10, 1938. Cytologist, National Cancer Institute, United States Public Health Service, Washington, D. C.

and fairly satisfactory. The cell is mounted on the camera as shown in figure 1. In this figure the cell (A) is shown mounted in a holder attached to a



swinging arm (B). The opposite end of this swinging arm rests in a yoke (D) which is rigidly attached to the plate holder end of the camera. This arm floats in the yoke and is not attached to it. At the yoke end of the supporting arm a shaft (C) is passing through it, and is arranged so that it can slide easily along the shaft. The shaft in general is round in section, except for one side, which is flattened, and the hole in the arm (B) through which this shaft passes has a correspondingly flat side. Therefore while the arm can slide lengthwise along the shaft, it cannot revolve around the shaft.

The shaft is mounted in two bearings (J and F), attached to the top and bottom ends of the camera respectively. The shaft may be turned in these bearings by means of a short handle (G).

The general design of this mounting is such that from the lower end of the camera, by means of the handle (G), the photoelectric cell can be swung out over the ground glass of the camera, or can be swung clear of the ground glass. A small flat metal light shield (E) is provided to cover the surface of the photoelectric cell when it is swung clear of the ground glass.

Electrical connections are soldered directly to the outlet taps of the photoelectric cell. They then run through a double pole, single throw snap switch (I), and from there run the length of the room and connect to the galvanometer.

The galvanometer and light source are located on a shelf about ten feet above the floor, at the far end of the room from the camera. This shelf is fastened directly to the wall of the room. In any room sufficiently free from vibration for photomicrography it is believed that a vibration-absorbing mounting for a galvanometer of the type used is unnecessary. The galvanometer used is a Leeds and Northrup reflecting galvanometer, type No. 2500A, sensitivity of .5 microvolt per millimeter at one meter, a period of 5 seconds, a critical external damping resistance of 50 ohms and a coil resistance of 12 ohms.

Since it is generally convenient or necessary to work with dim light in the room, it is found advantageous to use a galvanometer light source in which the indicating line is the incandescent filament of the light bulb. The light source actually used is a clear one-hundred watt bulb in a lamp-housing with a simple double convex condenser, such as is found in various microscope lamps. The lamp is set about 12 inches in front and to the side of the galvanometer, and the condenser is so focused that the image of the filament of the lamp globe is reflected as a vertical line of light on the wall of the far end of the room, that is, on the wall in front of the operator of the camera. On this wall at a height of about 8 feet from the floor a scale is mounted. The scale used is made by ruling lines at 5 mm. intervals on a strip of graph paper, 2 meters long and 20 cm. wide. Each tenth line is longer than the others and is numbered. Lines and numbers are clearly visible from the camera without effort. It is along the gradations of this scale that the beam of light travels.

Calibration of the Equipment

All determinations of the light intensity may be made with the ground glass in place in the camera, thus the light coming through the ground glass strikes the photronic cell. If preferred, however, the ground glass may be removed. Whatever method is used should be used consistently. Where a ground glass is used with a small clear area in its center, the photoelectric cell should not be placed directly over this clear area as it will give a slightly different reading.

When ready to calibrate the equipment the galvanometer light is switched on, the photoelectric cell is placed over the light shield E (see Fig. 1), and switch I is turned on. Some object, such as a micrometer slide, which has

dark areas of negligible size is focused on the ground glass, and the light intensity reduced to about the intensity range desired. The cell is then shifted out over the camera for a short time and then returned to the position over the shield. After a few seconds the value of the deflection on the scale will settle to what we can for convenience consider true zero for the electrical system. The photoelectric cell is then swung out over the camera and the deflection from this true zero is considered as indicating the intensity of light. After reading the value the photoelectric cell is returned over the shield (E).

Having established the deflection on the scale with the selected light intensity, a test negative is made using the usual increments of time for different strips on it, e.g., 1, 2, 4, 8, 16, etc., seconds. After processing the plate, the correct exposure is selected from it for the light intensity used. With our own equipment, for instance, a deflection of 20 scale lines gives a correct density of negative in two seconds when using a Wratten "M" plate.

After this initial determination, other exposure times corresponding to other light intensities may be easily calculated. If the light intensity is doubled so that the scale deflection is doubled, then the exposure time required is reduced to half. Similarly if the scale deflection is halved the time required is doubled. As may be seen, the whole scale may thus be calibrated from the single test negative.

While this type of photoelectric cell functions satisfactorily over the light range we use in photography, it appears to return to what we consider true zero rather slowly after exposure to extremely bright light, or after having remained in the dark for a relatively long time. In order to eliminate this lag action as a source of delay and error, when the cell is not in use it is kept covered by the shield (E) which fits quite close to the face of the cell, thus eliminating the possibility of the bright light in the room striking it. Also, when the cell has been in the dark for some time, it is advisable to swing it over the lighted camera for a few seconds before determining either the zero point or the light deflection. With these precautions the equipment is absolutely reliable.

It is also to be noted that the readings of the zero position and the deflections from this zero should be made by shifting the position of the cell, or by cutting the microscope light off and on, or by closing and opening the camera shutter, and never cutting the switch (I) off and on. The reason is, that with the switch (I) open, the position of the light beam on the wall bears no relation to the true zero readings.

It is advisable to recheck this calibration about once a year.

Use of Equipment

Once this calibration has been established it may be generally used without further complications for the same photographic emulsion and processing conditions for all lightly colored objects and relatively transparent objects. With very opaque objects, however, care should be taken that the light reaching the photoelectric cell passes through the object, and that the cell does not receive light from the brightly lighted field surrounding the object itself. A very small area of such a brightly lighted field can give a disastrously incorrect reading on a relatively opaque object.

The light intensity coming through the optical system of the microscope may, as usual, be regulated either by inserting a variable resistance in circuit with the microscope lamp, by opening or closing of the iris diaphragms, or by the insertion of neutral filters into the optical system below the substage. The latter method is found quite useful and, since the Wratten neutral filters are used, no difficulty is experienced in obtaining the correct exposure. With certain so-called neutral filters of glass, however, the light which is transmitted is so highly colored that the filters must be corrected for color as described below, rather than as neutral filters of known density.

With highly colored objects, or with color filters, a correction factor is of course necessary. In general, with the Wratten "M" filters it is satisfactory to calibrate the equipment with each color filter or filter combination. Once established, these calibrations give quite satisfactory results.

In some instances where an extremely slow film is used the desired high intensity of light causes the galvanometer to swing completely off the scale. This is easily remedied by covering all but a small area of the photoelectric cell with an opaque removable diaphragm and then recalibrating the cell for this reduced surface area.

If each such photoelectric cell is equipped with a switch as described, it is quite practicable to operate two or more cells on one galvanometer, thus allowing each of several photographic equipments to have its own photoelectric cell. Each cell, however, should be calibrated separately.

Summary

A photoelectric exposure meter assembly is described. This assembly is particularly adapted for use in photomicrography and other such work where a non-portable unit is desired for use with dim light. The method of applying this equipment in photomicrography is described.

THE PHOTOGRAPHY OF EXPERIMENTAL PLANTS IN THE STUDIO

JULIAN A. CARLILE*

FOR the best results in photographing plants to show lesions caused by disease or nutritional deficiencies, it is desirable to have the specimens brought to the studio. In the greenhouse or outdoors it is very difficult, if not impossible, to secure proper lighting and backgrounds. Shadows from the greenhouse frames are particularly objectionable.

This article will describe briefly the apparatus used, and its application with some of the subjects most frequently encountered in our laboratory.

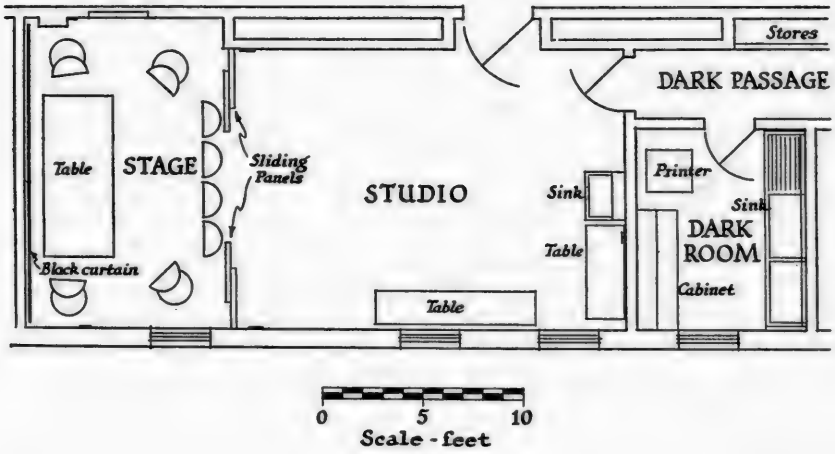


Fig. 1.

The studio (fig. 1) is a room approximately fifteen feet wide and thirty feet long. There are three windows on the northwest side which are equipped with dark shades. At one end of the room there is a floor-level stage (fig. 2a), extending the full width of the room and about ten feet deep. The rear wall is painted white. A black velour curtain overhangs this wall. The curtain may

* Received for publication September 16, 1938.

From the Illustration Division of the Rockefeller Institute for Medical Research, Department of Animal and Plant Pathology, Princeton, N. J.

be stretched flat against the wall or pulled aside at will. The white wall with its black curtain makes it possible to change readily from a light to a dark background when necessary. Ten feet in front of the wall there is what might be called a large black "mask," made of sliding panels of black velour, with a roller curtain of the same material hung from the ceiling. This mask shields the camera from the lights and permits a continuation of the black background to the edges of the picture, thus eliminating any handwork on the negative.

There is a large, metal-frame table on rubber covered casters, which may be moved to any part of the studio. This table is usually placed directly in front of the end wall of the stage. The top is made of a hard, black, asbestos composition and measures eight feet by forty-two inches. The top may be raised or lowered from a height of eighteen inches to thirty inches from the floor, by a worm gear operated by a hand crank. For subjects requiring a dark background the table is covered with black felt; for those requiring a light background, light colored wrapping paper or white blotters are laid on top of the felt.

Near the ceiling and inside the sliding panels there are four 1000 watt lamps in reflectors. These lights are mounted on joints permitting them to be turned in any direction. For side or back lighting there are four metal light stands on caster bases. Two of these stands have two lights each and are the same type of reflectors as are in the ceiling lights. They are mounted one above the other on one inch heavy brass tubing. The other two stands have one light each, similarly mounted. There are also two Kompakt Ventlites, with 500 watt inside-frosted bulbs, on folding stands. Each light is controlled by a separate switch in a wall panel. There is in addition, a magnetic switch, controlled from a toggle-switch at the end of a long cable. This portable switch may be carried to any part of the room and controls all the lights selected for use at the wall panel.

The camera generally used is a Folmer-Graflex 8 by 10 inch Century Universal, with an extra 5 by 7 inch back. Nearly all of our negatives are of the 5 by 7 inch size. The camera is mounted with tripod screws on a very flexible stand designed by Louis Schmidt. A similar stand was described in this journal by Schmidt and Haulenbeek.[1] A mirror, mounted in a wooden frame at a forty-five degree angle, is set in place above the ground-glass, to facilitate focusing when the camera is used in the vertical position.

The lenses used with this camera are the various combinations of a Zeiss Protar Set "D." This set contains four separate, fully corrected, Protar lenses,

[1] Schmidt, Louis and Haulenbeek, Joseph B.: A method of photographing gross specimens. *Jour. Biol. Photo. Assn.*, 1:76, Dec. '32.

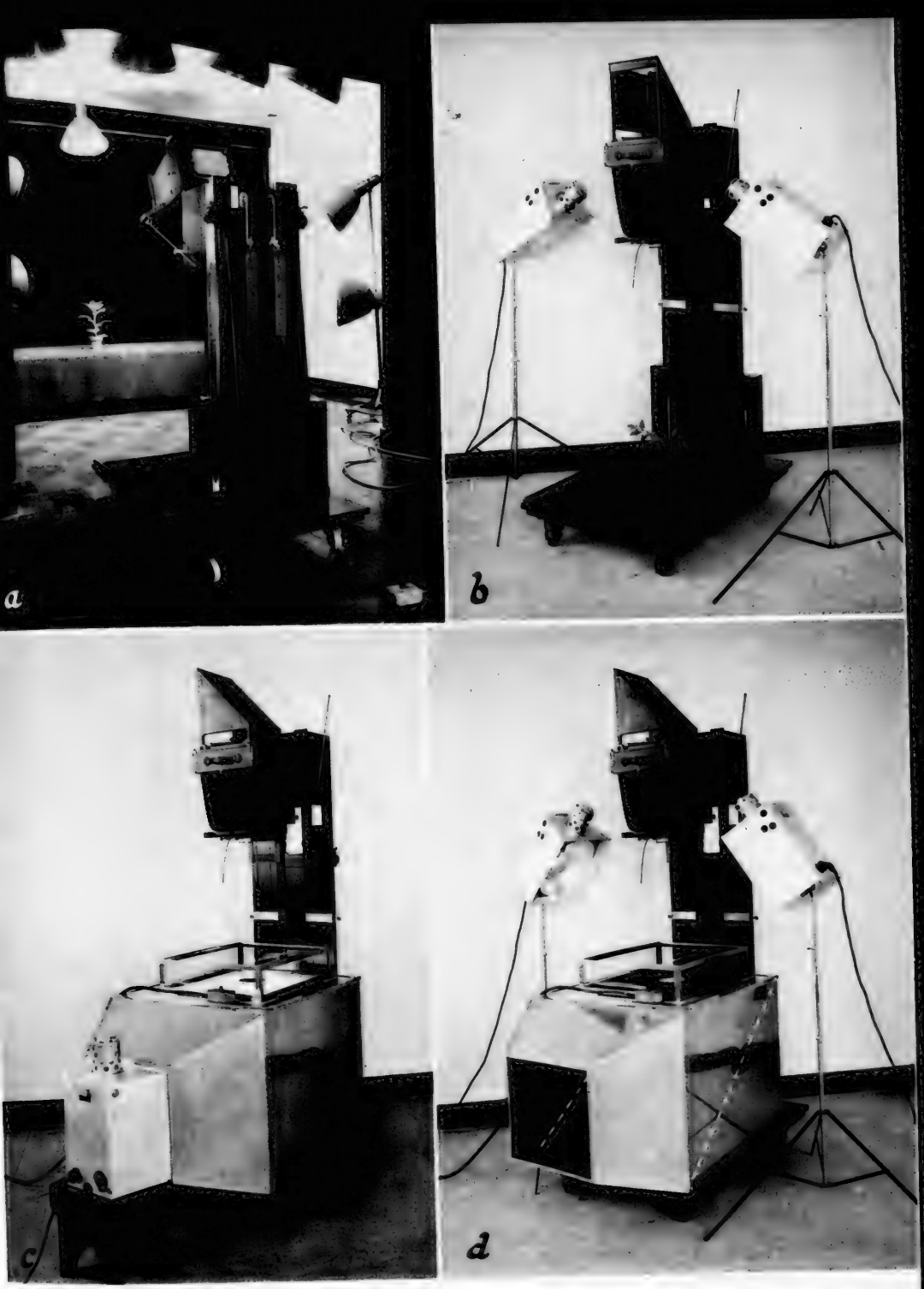


Fig. 2

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having focal lengths of 29, 35, 41, and 48 cm. In combination, these four lenses will provide the additional focal lengths of 18.5, 20, 22, 23.5, and 26 cm. A Compound shutter is used with this set. There is also a Schneider Angulon wide-angle lens with a focal length of 12 cm.

Cut film is used exclusively, with the exception noted later. Three types of panchromatic films are used—extra-fast, fine-grain medium speed, and process; two types of orthochromatic film—extra-fast and commercial; and two of the ordinary or blue-sensitive type films—commercial and process. The use of filters with these films depends on the color of the subject and the contrast desired. Tanks are used for development. For soft negatives Eastman formula D-76 is used, and for strong contrast the Eastman D-19.

For potted plants against a dark background (figs. 2a and 3a), the plants are arranged on the felt covered table top. The principal lighting is obtained from the four front ceiling lights. The side lights are used at a height which will satisfactorily illuminate the shadows cast by the overhanging leaves. The exposure is gauged by a Weston meter reading, taken on a medium grey card which is placed directly in front of the plants.

The same type of subject with a light background (fig. 3b); the black curtain is pulled aside and the table covered with a sheet of light colored paper. The table is moved about four feet from the wall, which is illuminated very strongly with the two double lights. This eliminates the shadows of the plants which are cast against the wall, thus producing an even white background. In most cases, where a size comparison is to be shown or where no color correction is necessary, a fast, backed, panchromatic film is used, in preference to the orthochromatic, in order that the red pots will not appear too dark in the finished picture; otherwise an orthochromatic film would serve the purpose as well, in many cases. The films are developed with the D-76 formula, according to the time and temperature recommended by the manufacturer for a gamma of 1.0.

For photographing the tops of small potted plants (figs. 2b and 3h), the plant is placed on a sheet of dull black cardboard, and set on the base of the camera stand. The camera is tilted to the vertical position. One 500 watt lamp in Kompakt Ventlite reflector is placed on each side of the camera stand, as shown in fig. 2b. A Weston meter reading is taken on a medium grey card held just above the top of the plant. A small stop, f.22 or f.32 is used to secure the necessary depth of focus. The choice of film and filter will depend upon the type of subject and the photographic effect desired. Viewing the subject with a Wratten Filter Test Chart will often help in the selection of the proper filter.

For photographs of separate leaves, groups of leaves, or other small objects, a light-box similar to that described by Louis Paul Flory[2] is placed on the base of the camera stand. This is a large aluminum box about 48 inches long, 28 inches wide and 25 inches high. There is an opening in the top about 16 by 20 inches with an opening in one end just large enough to accommodate one of the Kompakt Ventlite reflectors. Inside the box, facing the light, is a forty-five degree reflector, which throws the light from the lamp directly up through the opening in the top. The top is covered with a piece of plate glass or a plate glass aquarium about five inches deep. The aquarium is used for objects which must be submerged in water to prevent highlights or to keep the material from drying in the air. This box may be used for a variety of lighting effects, some of which are described herein.

In some leaves and cultures the best results are obtained by using transmitted light. This type of illumination is particularly necessary in photographing leaves showing clearing of the veins and in lesions which produce areas of greater or less opacity than are found in the normal parts of the leaves. For this type of subject, the specimen is placed on the glass plate on top of the light-box. The reflector inside is covered with a white blotter to produce an even, diffused light. The 500 watt reflector unit is placed at the open end of the box. The exposure time is determined more or less by experience; taking into account the camera extension relative to the focal length of the lens, the type of film and the thickness and color of the specimen. When properly used, this method produces a very clear reproduction of the specimen on an even, white background. Care must be taken not to overexpose or underdevelop. Development is usually timed for a relatively strong contrast. The set-up and results are shown in figs. 2c and 3e.

For specimens in which the lesions or structures appear to best advantage by reflected light, the following method is used. The white blotter reflector is replaced with a piece of black velour on a wooden frame. The specimen is placed on the glass plate and illuminated with one 500 watt light on each side (fig. 2d). The lights are placed in a position to bring out clearly the texture and surface irregularities in relief (figs. 3d, 3i and 3j). For yellow or light colored lesions on green leaves it is usually satisfactory to use a medium speed panchromatic film with one of the following Wratten filters or their equivalent: G, No. 15, deep yellow, for moderate contrast; E, No. 22, orange, for strong contrast; and A, No. 25, red, for extreme contrast. When the lesions are brown or very dark in color, a green sensitive material with a green filter

[2] Flory, Louis Paul: Apparatus for photographing large objects by transmitted light. *Amer. Photog.* 26:208, '32.

FIG. 3.

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will be found most suitable. The Wratten Metallographic plate has the highest green sensitivity of any emulsion we have tried; and with a B, No. 58, green filter has proven extremely useful for this type of specimen.

Another method of lighting which will often be useful is a combination of transmitted and reflected light. This is most suitable for opaque objects, like seed pods, twigs, and similar material, which appear to best advantage on a light background without shadows (fig. 3c). For this method the forty-five degree white blotter reflector is used in the box. Both the transmitted light and the two side lights are used. All of this illumination is used during the entire exposure, or any one or two of the lights are turned off for part of the time, depending on the effect desired.

Thin opalescent material, transparent cultures, or cloudy material in a transparent liquid are photographed by a method similar to darkfield photomicrography. The black velour is used in the box as a background. The specimen is placed on the glass plate and illuminated from below with the light at the open end of the box (fig. 3g).

The photography of plant roots in water, against a black background, has given us considerable trouble. The roots are placed in the aquarium in distilled water and held in place with black threads attached to the glass with Scotch tape. It is interesting to note that Scotch tape will adhere to glass even when applied under water. The illumination is the same as for the photography of leaves by reflected light. The two surfaces of the thick glass plate cause a reflection to be cast by each of the roots which is almost as dense on the negative as the image of the actual roots. It is usually necessary to scratch out all these reflected images on the negative. It was later discovered that by placing a sheet of dark green glass on the bottom of the aquarium, with the flashed or colored surface of the glass uppermost, and by arranging the roots on this glass surface (fig. 3f), the reflections can be entirely eliminated. The negative is made on process panchromatic film with a Wratten A, No. 25, red filter. The red filter absorbs the reflections coming through the green glass. A red glass used with orthochromatic film together with a green filter gives similar results. The Wratten Metallographic plate is recommended in this case. Obviously, this method is not confined to roots or materials under water.

The great variety of subjects encountered make it difficult to describe a standard routine. The above procedures suffice in a general way, but each subject is likely to require more or less drastic modification of the technic herein described.

SURFACE ILLUMINATION IN LOW AND MEDIUM POWER PHOTOMICROGRAPHY

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PART 2. WITH THE USE OF A MICROSCOPE

FOR photomicrography exceeding a magnification of fifty diameters and requiring the use of microscopic objectives with oculars or Homals, the refined adjustments of a microscope are necessary. It is obvious that in order to secure the point of best focus with ease, especially when using the newer illuminating systems for dark field surface illumination, a good microscope becomes essential.

The simplest of the new illuminating devices is the Zeiss Epi-lamp 8, shown in figure 6. It carries the standard thread of the microscope tube, and is held

* Part 1 appeared in Vol. VII, No. 1. Received for publication September 29, 1938.

Fig. 1. Epi-condenser W, with regular lamp and condenser removed to allow use of a stronger light source for photography. Compressor shown on microscope stage

Fig. 2. Epi-mirror with regular illuminator used for visual observation

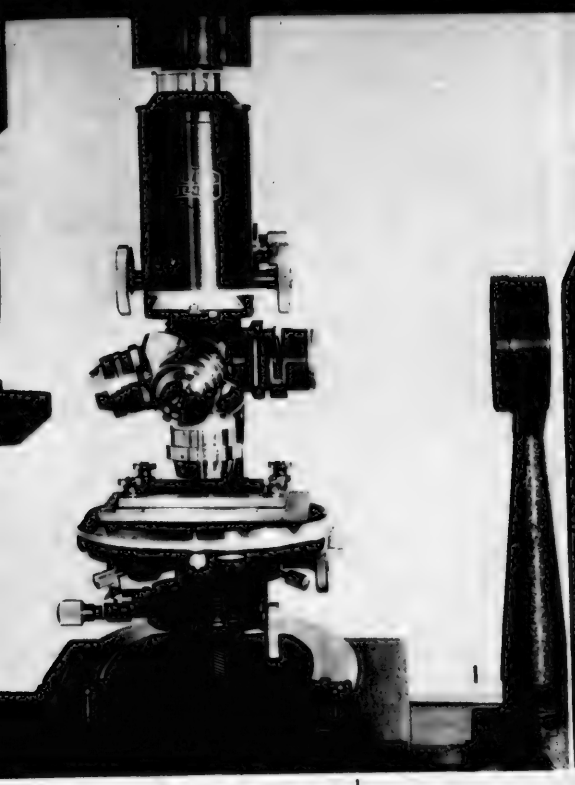
Fig. 3. Path of light rays in Epi-condenser W (after F. Hauser)

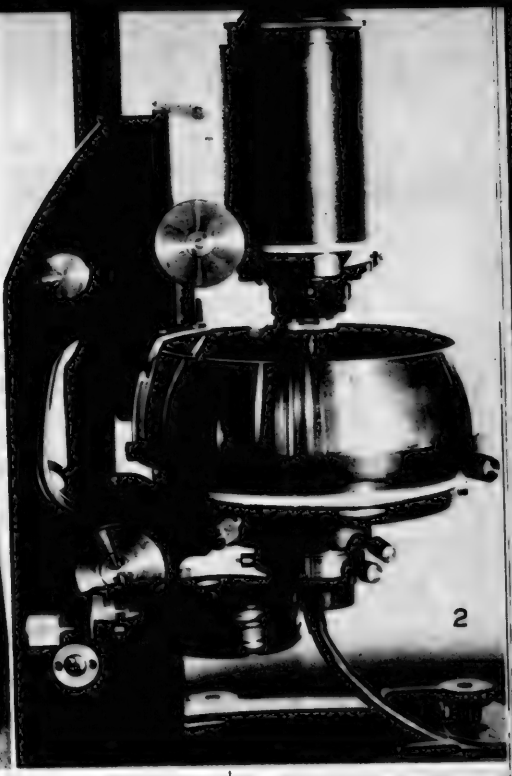
- L Low voltage lamp
- k Collecting lens
- rr Annular ring-shaped silvered glass plate
- a Objective
- KK Annular concave mirror
- O Object

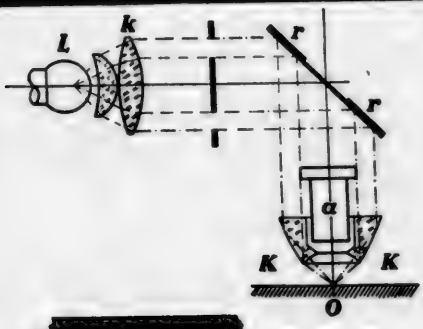
Fig. 4. Path of light rays in the Epi-mirror (after F. Hauser)

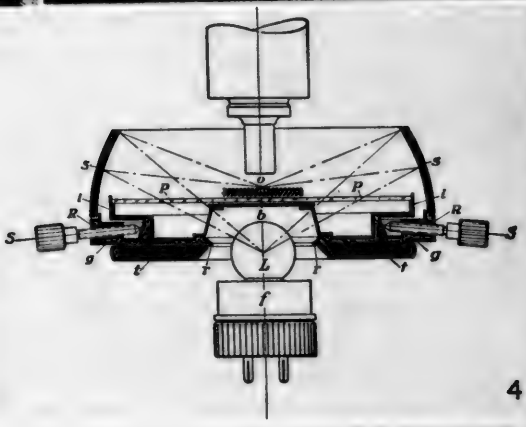
- gg Circular base plate
- tt Microscope stage
- rr Flange of base plate set in microscope stage opening
- RR Outer ring for concave mirror, ss
- pp Clear glass stage of heat absorbing glass
- o Object
- ii Centering support for glass stage
- L Lamp in mount, f
- SS Centering screws

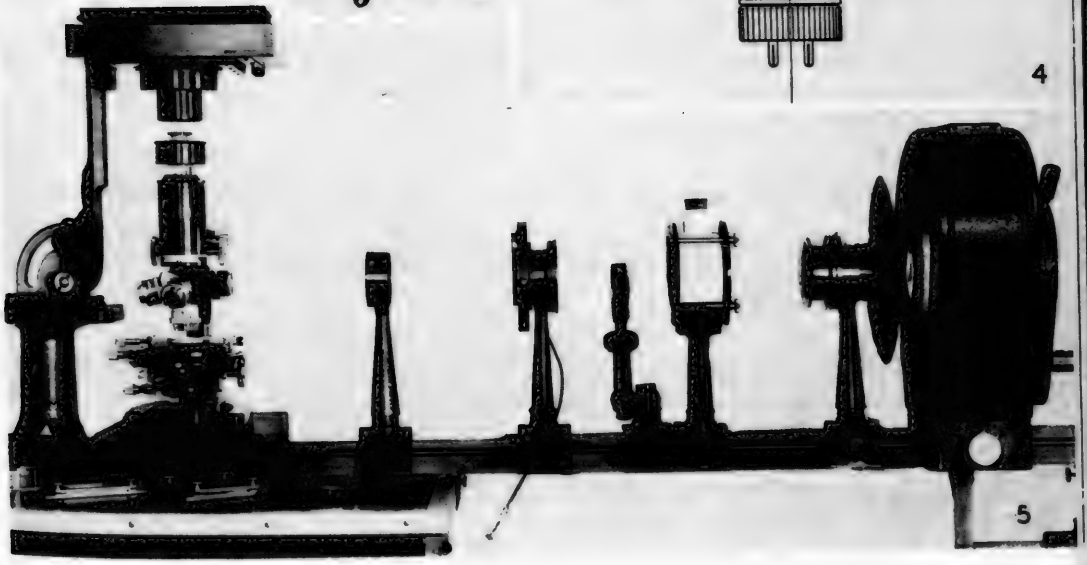
Fig. 5. Epi-condenser W with complete illuminating system for photography











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in position between the tube and the objective. The small housing is mounted on a revolving carrier. The light is collected from an 8 volt 0.6 ampere bulb in a centering holder, by an aspheric condenser which brings the light beam at focus on the object below the objective. The lamp is supplied in two types; the first with lamp and condenser fixed in relation to the side swing of the lamp, and is indicated when all the objectives are parfocal; the second type has an added ball joint which allows an adjustment for use with objectives of varying lengths. The light control consists of an adjustable rheostat which reduces the light for visual observation if necessary. For photography the lamp is used at full intensity. The following microscopic objectives can be used with this illuminator; achromats x6, x8, x10, apochromat x10 and achromats Epi x20 and x40. Figures 10 and 11 show the result of one directional lighting within a restricted light area. The images are portions of the dot over the letter i, and show the ink absorption of two grades of papers at a magnification of 238 diameters.

With the illuminating system Zeiss Epi-condenser W, three forms of lighting are achieved; vertical or light field, transmitted light by means of a substage condenser, and dark field surface illumination. The latter will be considered herein only. For visual use, this device projects the light, by means of a condenser, upon an annular silvered glass plate inclined at 45 degrees, which in turn reflects it vertically downward and around the specially mounted Epi objectives upon the annular concave mirror surrounding the objective. Figure 1 shows three objectives on a revolving nosepiece surrounded by their concave mirrors. The lamp for visual use has been removed to allow the use of an illuminating system of greater intensity. The path of the light rays is shown in figure 3. The objectives and corresponding annular concave mirrors are mounted on a triple revolving nosepiece and each Epi objective threads into annular glass discs, mounted on the screw attachment tubes of the concave mirrors. Thus, complete and unbroken illumination from all sides is obtained. For visual use an 8 volt 0.6 ampere lamp with a two lens condenser suffices. For photography, however, a more powerful light is preferred in order to secure shorter exposures. Figure 5 illustrates a collecting system of greater intensity. The optical bed holds a lamphouse with a 500 watt projection bulb, air blast cooled, a saddle stand in front carrying a 12.5 cm. single lens with iris diaphragm, followed by a water cell for cooling the light beam. The next two saddle stands are not used but a K29 condenser on saddle stand completes the system, filling the tube of the Epi-condenser with light. It is remarkable how

structure and detail of dark colored objects can be recorded by this method of illumination. Figure 12 shows a black typewriter ribbon, figures 13 and 14 textiles of woven synthetic fibers of dark navy blue and black. Lighter colored objects are shown in figures 15, 16 and 17. Twelve specially mounted achromatic Epi-objectives are available, with primary magnifications from x3.75 to x50 with five annular mirrors for use with them. A rotating azimuth stop can be placed between the slider for dark ground illumination and the side tube aperture. This stop changes the complete illumination from the annular mirror to a partial one and is useful in lighting one side of an object to a greater extent than the other side.

The third device, the Zeiss Epi-mirror also concentrates light from all directions upon the object. It is used upon the revolving circular stage of the

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Fig. 6. Epi-lamp 8 with ball joint for adjustment to varying objective lengths

Fig. 7. Paint. Mill flat white. X 50
Objective. B. and L. 16 mm. short mount achromat
Ocular. B. and L. X 5 Projection
Eastman Process film
Five ampere arc. Light beam 14 degrees to the object

Fig. 8. Crystal structure. Large and long interlocking crystals in a coiled tungsten filament. X 100
Objective. Zeiss 16 mm. short mount apochromat
Homal II
Glass plate vertical illuminator
Five ampere arc lamp
W. and W. Metallographic plate
Specimen ground and polished

Fig. 9. Crystals of Monocalcium phosphate. X 80
Objective. Zeiss X 6 apochromat
Homal VI
Light beams from three illuminators to surface of crystals
Eastman Commercial film

Fig. 10. Paper and printing. Part of dot over the letter *i*.
Good grade of magazine paper. X 238
Illuminator, Epi-lamp 8
Objective. Zeiss 16 mm. apochromat
Homal I
Eastman Commercial film, anti-halation

Fig. 11. Paper and printing. Part of dot over the letter *i*.
Coated half-tone paper. X 238
Data as in figure 10

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microscope and has a more restricted use than the two devices previously described. Due to its construction, only objects of limited size can be used on the central spot under the glass plate above the centering stage. The part reflecting the light consists of a large annular concave mirror which rests upon the stage of the microscope. The light source is a 6 volt 1.1 ampere lamp in a centering holder, which is inserted in the substage condenser sleeve of the microscope in place of the regular condenser, figure 2. The path of the light rays is shown in figure 4. The light from the lamp is reflected from the concave annular mirror as a spot of light, on the object, which lies upon a heat-absorbing glass plate. A rotating azimuth stop can be placed upon the glass plate thus permitting a cone of light of 80 degrees to fall upon the object. This set-up is useful in stepping up contrast a trifle. The same objectives which are indicated for Epi-lamp 8 may be used, as well as the standard and short mount objectives regularly used on the microscope. An outside light source may replace the lamp in the centering holder by using a substage condenser, having a numerical aperture of about 1.0, and directing the beam of a powerful light source toward the mirror and substage condenser. By raising or lowering the condenser, a point will be reached where the rays will be picked up by the large annular mirror and reflected toward the object.

While the two latter devices described give a more convenient means of securing dark field surface illumination for visual observation and photomicrography than those in more or less general use, good results are accomplished by the use of the regular microscopic objectives and oculars, plus one or more surface illuminators as outlined in Part 1 of this series of articles. This only involves the use of a microscope in place of the focusing mounts and elevating stands. Three photomicrographs made in this manner are shown. Figure 7 is a photomicrograph of a flat white paint, which due to the irregular surface holds dust and dirt. The illumination consists of one illuminator placed at an angle of 14 degrees. Figure 8 is a photomicrograph of a metallurgical specimen illuminated by means of a standard vertical illuminator. Figure 9 is a photomicrograph of selected crystals arranged on a black glass slide, illuminated by three beams of light directed toward the surface of the crystals.

Little of value can be given regarding the time of exposure, other than to state that experience is the best guide. The only positive method is to make a set of step exposures on a plate or film and then select the one best suited for the problem at hand. Notwithstanding that many tables have been computed to simplify this question of exposure time, too many variables arise that make

them worthless. While the optical conditions remain constant, variations occur over which there is no control, such as: the rise or fall in the line voltage which affects the intensity of the light beam; the small differences in speed between different batches of emulsions; the use of various types of developer; the changes in the concentration of the developer, and the use of plates or films of varying speed and color sensitivity. Fortunately, there is considerable exposure latitude in emulsions, and there is more leeway in printing papers which now range from very soft to extreme contrast. Nevertheless it is advisable to produce a normal negative if possible, one that will give a good print on Azo F2 or paper of similar speed. Thus the factor of latitude is reserved for those negatives which will require the use of a soft or hard paper to produce a print of desirable contrast.

Fig. 12. Black typewriter ribbon. X 50 Epi-condenser W
Objective. Achromat Epi X 7.5 N.A. 0.20
Ocular. Winkel-Zeiss photo eyepiece X 4
Complete illuminating system as in Fig. 5
Eastman Commercial film

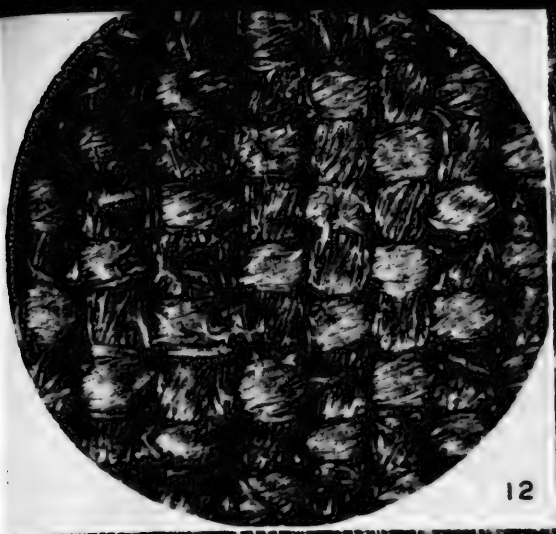
Fig. 13. Navy blue Celanese fabric. X 47 Epi-condenser W
Objective. Achromat Epi X 5.7 N.A. 0.17
Other data same as Fig. 12

Fig. 14. Black satin rayon. X 60 Epi-condenser W
Data same as Fig. 12

Fig. 15. Inner frosting on a domestic electric light bulb. X 400 Epi-condenser W
Objective. Achromat Epi X 21
Ocular. Zeiss orthoscopic X 12.5
Illumination. Beam from five ampere arc to condenser on saddle stand fills the tube of the Epi-condenser W
Eastman Process film

Fig. 16. Citric acid crystals. X 45 Epi-condenser W
Objective. Achromat Epi X 7.5
Ocular. Winkel-Zeiss photo eyepiece X 4
Complete illuminating system as in Fig. 5
Eastman Commercial film

Fig. 17. Crystals of Vitamin C. X 82 Epi-condenser W
Objective. Achromat Epi X 5.7
Ocular. Winkel-Zeiss photo eyepiece X 6
Complete illuminating system as in Fig. 5
Eastman Commercial film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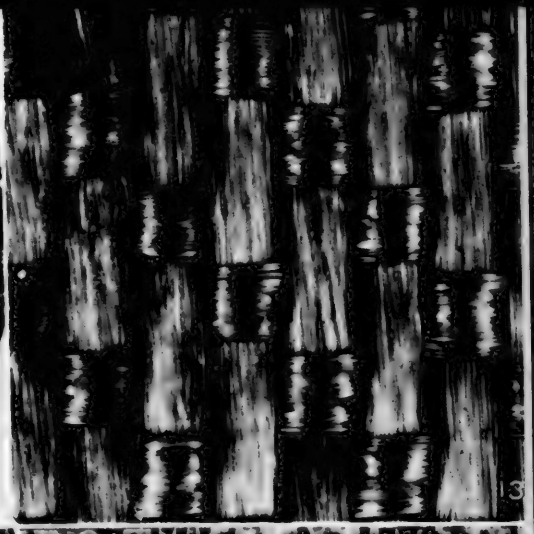
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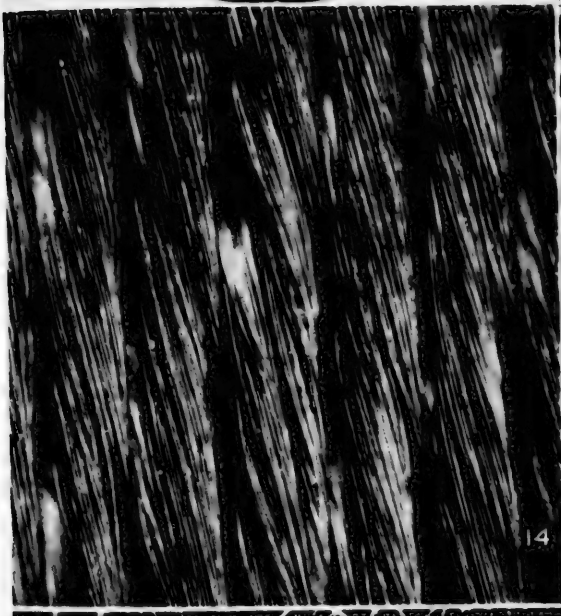
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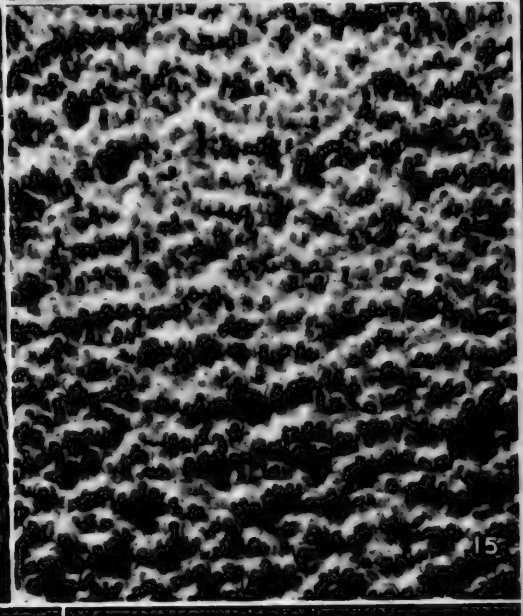
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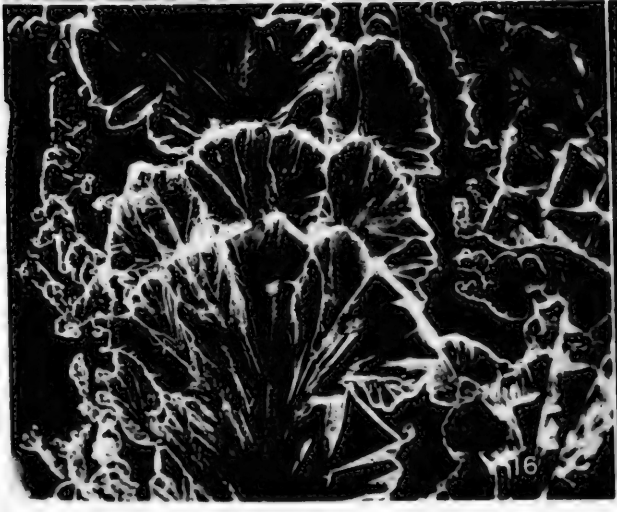
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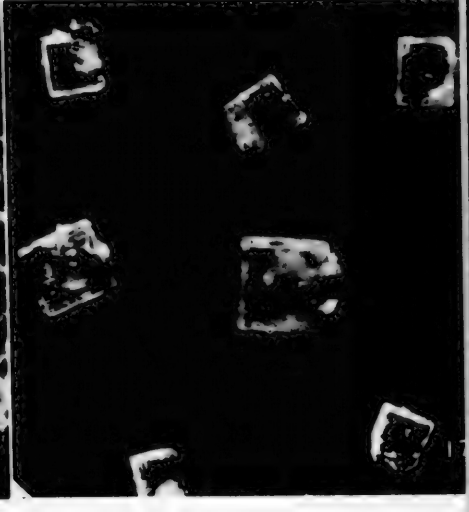
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CHATS WITH THE EDITOR

IN introducing this column to our readers I believe it timely to discuss briefly: my general thoughts in assuming the editorship of our journal; to encourage our members to contribute to our publication.

Foremost in my general thoughts is, that I consider it a distinct honor to have the opportunity to attempt to contribute something toward the destinies of our journal. My efforts will be directed toward improvement at all times. My goal—to maintain a wide-awake journal with the avowed purpose of supporting, encouraging and improving the field of biological photography. These ambitions may be realized only by the whole-hearted cooperation of our members.

It is most gratifying and encouraging to note the personnel of the editorial board: Dr. A. W. Proetz, Miss Anne Shiras, Mr. Ferdinand Harding, Mr. A. W. Fuchs. I am mindful of the fact that these individuals are sacrificing considerable of their time in the interest of our journal, and I am grateful for their services.

In the field of photographic literature THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION is filling a very deep and individual need. Obviously, the study of biological photography is of particular importance to the biological scientist. Increase in its usefulness, however, will depend entirely upon improvement in technic and equipment.

Photography in general is deeply indebted to engineers, physicists, and inventors for the amazing efficiency of present-day photographic equipment. However, fruitful results seldom come even to the ablest photographer unless his work is systematic and in accordance with the principles of a well-recognized general procedure. Hence it devolves upon the contributors to our journal to bring before our readers new developments and improved equipment, which necessarily will involve changes and improvement in photographic technic.

Again I say that this journal should maintain sufficient appeal to draw upon the vast knowledge and range of thought which is so prevalent in the biological sciences, and should contain the most satisfying accounts of the progress in this broad specialized field of photography.

This column will at all times lend a sympathetic ear to any comments or suggestions from its readers for improvement of the JOURNAL.

In the next issue of the JOURNAL there will be included a section on abstracts of current photographic literature. With the addition of this feature we hope to keep our readers informed as to scientific photographic developments.

THE EDITOR.

KODACHROME VS. MONOCHROME IN FILMING SURGICAL PROCEDURE

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Photographic Department, The Mayo Clinic

THE filming of surgical procedure was greatly simplified when 16 mm. Supersensitive Panchromatic film was placed on the market a few years ago. Since that time many surgical films have been produced in monochrome. With the advent of Kodachrome film, it is now comparatively simple to produce such films in color. Moreover, the cost of Kodachrome film is not importantly greater than that of Supersensitive Panchromatic film. In making the change from black and white to color photography, the experienced photographer will note differences in the characteristics of these films, thus necessitating a change in the photographic technic.

The greatest difference in the technic involves the control of the illumination when using color film. Few operating rooms have sufficient daylight to permit the use of ordinary Kodachrome film, hence the Type A is generally used. Since this film is balanced for use with artificial light, all daylight must be eliminated from the room. If all the operating rooms are not fitted with window shades it may be necessary to plan the surgical list so that the filming is done in a room that can be darkened. While the film is balanced for use with Photoflood bulbs, satisfactory results are obtained when using 500 watt, 105 volt projection bulbs on a circuit carrying 115 volts. These bulbs have a longer life and produce a brighter light than the ordinary Photoflood bulbs.

For general views of the operating room with black and white film, daylight may be used in conjunction with the photographic lamp. As the daylight must be eliminated when using color film it may be necessary to provide additional lamps for general illumination. For the ordinary surgical field one or two lamps in reflectors are adequate with either type film. With Kodachrome the exposure time must be very nearly correct. During the operation, as light or dark tissues are encountered, the exposure time will vary.

When using Supersensitive Panchromatic film, the presence of blood appears minimized, while with the color film it seems exaggerated. Thus the

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surgeon and his assistants must exercise greater effort to keep the field dry. The use of color film tends to delay the progress of the operation because soiled wound towels must be replaced often. For some procedures, as in plastic surgery of the face, the surgeon may use local injections to obtain a hemostatic effect. With color film, colored draperies may be used, care being exercised that they do not become too conspicuous in the finished film. Light brown rubber gloves produce a better photographic effect on Kodachrome than do the dark colored ones.

With either the Kodachrome or Supersensitive Panchromatic film, it is advisable to use a lens of the focal length which gives the greatest magnification with the desired area. With monochrome film the lenses may be changed quite freely, as the images are of one color. With color film the lenses are changed less frequently because changing the lenses alters the relative areas of color on the screen which in turn has a distracting effect. Since Kodachrome deposits a powdered form of emulsion the camera is cleaned and oiled regularly. In some cameras this dust may accumulate on the claw movement and stop the mechanism. A cleaning brush and small can of oil are kept in the camera case while filming, thus being accessible if needed.

Due to the many delicate steps used in processing Kodachrome film there may be a difference in tone of various batches processed. To insure uniform tone in the entire color record of a surgical procedure, the films should be processed at the same time in spite of any delay occurring before the balance of the last reel is exposed.

Careful editing is very important, regardless of the type of film used. Kodachrome can be used for making photomicrographs in color, while Roentgenograms copied on this film present a pleasing stereoscopic effect. For copies of hospital charts or drawings containing fine detail, monochrome film produces a sharper image. For this work positive film on a tinted base is used.

Beautiful results are obtained with color film if the surgical field is kept dry. If there is likely to be much oozing of blood, it is advisable to use black and white film, for this film seems to penetrate the blood, and record the details in the underlying tissues. The photographic results on monochrome films are more or less diagrammatic in effect and good for recording technic. The Kodachrome films are superior for the recording of differences in the color of tissues, thus producing more beautiful results in selected cases. There is a definite use for each type of film, and it is not likely that color will entirely supplant the black and white films.

DISPLAYS AND EXHIBITS

LOUIS SCHMIDT*

SOONER or later we are called upon to use our talents and ingenuity to devise plans for some type of display or exhibit and to carry the plans to completion. The object of such an exhibit is to publicize in a graphic manner the results of the research that has been carried on by our staff. To be effective, the display must tell the story in the shortest amount of text and in the smallest space. Too often charts and diagrams while good enough in themselves become useless when they are placed where they cannot be properly seen. When diagrams, illustrations and explanatory text are placed on a wall, only those parts from 3½ feet to 6½ feet above the floor are in a favorable position if the material is such as to require close inspection. The spaces above and below are of use only for the display of subjects on a larger scale which must be viewed at a somewhat greater distance.

Visits made to the exhibitions arranged in connection with large meetings are useful. Here you may see the problems handled very well and also very poorly. By observation and study it is possible to learn what to emulate and what to avoid.

A study of some of the commercial displays is highly recommended, because these are usually designed and built by professionals and as they are to be displayed repeatedly in different locations they have an air of solidity and permanence.

The simplest type of exhibit is one consisting of charts on cardboards bearing descriptive matter, curves, diagrams and illustrations, drawn, printed, painted, or photographed, arranged in sequence on the walls.

The size of the lettering and pictures is important and should depend on the distance from which they are to be viewed. If in the front of the booth there is a table or counter bearing exhibits and the observer is not able to walk into the booth, the display on the walls must be of a size large enough to be read and understood from the aisle. This makes it clear that the exhibit must be planned as a whole, each part in relation to and of a size to suit the place that it is to occupy.

* From the Illustration Division, The Rockefeller Institute for Medical Research, New York.

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The judicious use of color on diagrams, charts and curves adds to their value and for long descriptive charts the use of some lines of red lettering is advantageous.

If attendants are to be present to explain the exhibit the amount of descriptive material may be greatly curtailed.

On the tables in the front of the booth may be placed flat pictures, specimens, apparatus, etc. These tables should be high enough so that their contents may be viewed comfortably, and as they are to be examined at close range they may be on a relatively small scale. Such tables combine well with wall displays in booths if the latter are fairly wide so that the observer may pass behind the table and study at close range what is displayed on the walls.

If transparencies are to be shown on these tables the angle at which they are placed is important, especially if they are in color and screen plates are used. Transparencies add complexity to an exhibit, because of the lighting units, the wiring and they are difficult to transport.

As a rule it is not wise to use transparencies and pictures in close relation on the same wall or booth, for transparencies appear to best advantage in subdued light which does not do justice to flat copy unless it is specially lighted, and this may degrade the effects of the transparencies. Light units must be placed behind transparencies, thus bringing them forward from the wall and introducing irregularity of surface when combined with solid copy. Transparencies in monochrome and color make the most beautiful displays. Their housings are expensive to build, transport and illuminate, but they have an indefinable quality which should be utilized when possible. A great deal depends on the right type of illuminated display unit, which becomes increasingly difficult as it increases in size. The glass front is a particularly difficult problem because it involves weight, difficulty in handling and danger of breakage.

In the design and construction of these units the economical use of light bulbs is very important, to avoid excess light with its problems of glare, current consumption and undesired heat. To this end the power of the light bulbs, their type, number and distribution should be carefully studied. Reflectors or backgrounds of compo-board painted white or with aluminum paint should be placed behind them. Just behind the front glass, or better still, several inches behind, a sheet of ground glass, or tracing cloth serves as a diffuser to control spottiness. If in a unit of this type, a non-transparent chart or illustration, a piece of apparatus or a specimen must be introduced, it is a good plan to cut out a part of the glass front along the bottom and build behind it

a chamber 6 to 12 inches deep. It should be open at the top to admit light which will indirectly illuminate the chamber. The effect is very pleasing and combines well with its surroundings.

Transparencies and pictures may be combined to advantage if they are on a fairly large scale and are designed to be viewed at a distance of several feet, for example, at the back of a booth where there is a display table in front. This may be done by placing a row of transparencies on the eye line in a long viewing box open at the bottom and top. Directly below place a row of pictures at an angle, the lower edges flush with the transparencies, the upper edge 6 to 8 inches back. The light from the illuminator, through the open bottom, indirectly lights the row of pictures, and the effect is almost as if both rows were transparencies. If the name of the exhibitor in cut-out wooden letters is placed along the front top edge of the illuminating unit, the light from within will back-light the letters with pleasing effect.

If an all-transparent exhibit is to consist of a large number of different sized pieces it may be necessary to arrange them in an opaque mat, as when a number of photographs are arranged in one frame. When the pictures are fairly large, 10 x 12 or larger, and it is planned to fit them together in rows combined with explanatory charts in transparent material, they may be arranged edge to edge without a mat, making a continuous transparent exhibit of practically any size.

For monochrome transparencies Eastman Translite films, coated on both sides, or similar materials give excellent results. Drawings, diagrams and descriptive text may be made on the same material after the emulsion has been removed, assuring uniform translucence. The surface is excellent for pen work and color by air-brush. The black Translites may be colored by hand, front, back or on both sides. Small labels, to describe individual pictures may be inserted as cut-outs. These may be drawn, typed or printed. They are fastened in their places and the parts joined together, edge to edge, with Scotch Cellulose Tape. This is available in various colors and may be used to enclose or separate parts of an exhibit as well as to build up curves on large scale diagrams on the Translite background. It has been found that a large all Translite exhibit, its parts joined with cellulose tape only, will stand a great deal of heat for a long time without any of the joints becoming loose. A booth that is about the same width as depth may be arranged to show a large amount of material if the table in front is the full width, thus keeping visitors out. In this case the back may be utilized for fairly large scale pictures, and as they must be viewed at some distance a space from 1½ feet to 8 feet from the

ground may be effectively used. Also apparatus or large specimens could be shown on a low table 2 to 3 feet in front of the back wall.

The side walls of the booth would not be available, but wings could be built out from the sides either parallel to the front or sloping backward a bit.

Another arrangement much used for X-ray demonstration is a square box-like frame-work from 2 to 8 feet from the floor covered with tracing cloth, on which the films are fastened. Four legs support it and a single large light bulb serves as illuminant.

RECAPITULATION:

If possible, design material to fit its environment.
Visit exhibits and study good and bad points.
Transparencies, superior, but expensive.
Do not over illuminate.
Use great care if pictures and transparencies are combined.
Plan to have each part suitable in size for the place it is to occupy, considering its place and the distance from which it is to be viewed.

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A rather extensive treatise on the problems arising in the field of biological photography is contained in the JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION: "Some Problems in Biological Photography," by Max Poser, Ph.D., December 1932, Vol. I, No. 2. This excellent article contains valuable information involving photographic equipment, clinical photography, Micro-photography, Photomicrography and Cinematography.

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To facilitate rapid exchange from the ribbon filament to Photoflood lamps for Kodachrome "A" photomicrography, just attach two binding posts and a short wire extension to the table or baseboard bearing your equipment. When the exchange is to be made simply unscrew the leads on the secondary side of the transformer and fasten them to the binding posts. Exchange the lamps and go to work. No other adjustment is needed. Exposures are greatly increased over ribbon filament lamps.

WM. L. M. MARTINSEN.

PHOTOGRAPHIC TECHNIQUE, NEW PROCESSES, AND EQUIPMENT

Methods of Posing and Holding Infants and Small Children

F. R. HARDING*

MANY photographers are quite concerned when pictures of infants and children are requested. Infants, however, present the greater problem for usually they must be held by an assistant.

The value of having nurses to hold the patients, who are sympathetic toward children cannot be over-stressed. They often do more toward producing a successful photograph than does the photographer, for if the child is not kept quiet and in the correct position, photographic ability is of little value. Time spent in explaining to the nurse or attendant exactly how to hold the child is well spent.

Difficulties are sometimes encountered when children are sent to the photographic department from the Out Patient Department and arrive with the parent. Some children are aware of the fact that the parent will attempt to interfere when the child cries. In some instances the parent can quiet the child, but at other times they really make matters worse. In the latter case, the best procedure is to send the parent out of the room, and proceed with the photography, employing force if it is necessary, to keep the child in the desired position. Obviously, an efficient nurse or trained attendant is very essential in a situation of this type.

Sometimes one may tire out a child who goes into a tantrum upon approaching the examining bench. Proceed as usual in spite of the child's protests and hold the child in the approximate position. When he sees that howling is of no avail, often the child will calm down. Sometimes it is the photographer who tires first. The writer has great sympathy for the genuinely scared child who really cries, but no sympathy should be wasted on the dry-eyed howler.

The hands of the attendant holding the infant ordinarily show in the photograph, but by proper care and attention to detail, they can be made fairly inconspicuous. If the infant is being held in a sitting position for an anterior

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Hare lip photography, a method of wrapping the child's arms, and holding the head so that the face will not be distorted.

UNIV. OF MICH.

photograph of the trunk, a portable black drape is placed over the body of the attendant. The black drape is necessary to provide a plain background. The child is allowed to rest against the attendant, who holds the child under the armpits with two fingers of each hand if possible. The thumb of each hand supports the back. The finger tips should be as inconspicuous as possible, and care must be taken to avoid pulling up the shoulder line as the normal shoulder position is important in some diagnoses. A great deal of patience is required when work is done on infants, frequently many minutes of waiting are necessary when the patient is crying and irritable. Have the camera focused and loaded, and the shutter set, so that when there is a pause of a second or so with the child in the correct position, the exposure may be made. When a sitting position is not positively indicated for a trunk photograph, a blanket covered with a black drape may be placed on the floor and the patient placed flat on the back. The camera must be in a vertical position.

With the patient lying on the floor a good lateral view is impossible. For this view the patient is placed on the examining bench lying flat on its back. With the camera placed at the proper level, a good lateral view may be obtained. The patient seldom needs to be restrained in either of these positions, so that the attendant's hands do not confuse the pictures.

For photographs of the face, the child is held in the attendant's lap, employing a portable black drape as a background. Frequently a thin blanket is wrapped tightly around the child and pinned in position to restrain the patient's arms. The head is held in position by the attendant. One method of holding the head is to place the thumbs back of the patient's ears and extend the index fingers down under the jaws. Another method is shown in figure 1. Care must be taken that the patient's face is not pressed out of shape. To photograph an infant's head for contour as is necessary in hydrocephalus, and in other deformities, the best results are obtained by placing the patient on the floor for both anterior and lateral views. For the anterior view the head may be steadied by placing the end of the index finger at each side of the head. The rest of the fingers should be clenched into a fist. The fingers and fists may be etched off the negative subsequently if it is considered necessary and if a black background has been employed.

When weight-bearing photographs are required of children in the age group of 14 months to two years, the attendant should wear a black precaution gown, and if necessary should drape the head in a black hood so that there will be no distracting element in the background. The child should be sup-

ported below the armpits with as little as possible of the attendant's fingers showing.

To show tumorous growths such as meningoceles, the attendant's lap is draped and the infant laid across the lap. Both the posterior and lateral views are obtainable in this manner. The child's feet, arms or head are firmly held.

A child seated in a chair for oral cavity photography will sometimes suddenly arch its back. This can be prevented by fastening a webbed strap around the child and the back of the chair. Employing the strap in this manner also prevents the child from falling.

Infants with club feet may be photographed successfully by placing the child in the lap of the attendant, who sits on the examining bench in such a manner that the lap is inclined at about 45°. The camera is tilted to the corresponding angle. For the anterior photograph the child is held in a partly reclining position with the legs directed downward. The attendant grasps the patient's knees firmly so that the knee joint cannot be flexed and at the same time holds the body by pressure from the elbows. To make the posterior view the child is turned over and the head allowed to pass under the attendant's elbow, with the legs held as for the anterior view.

Photographs of infants with a diagnosis of torticollis present a severe problem. The writer has never found a method of solving this problem. If the infant is but a few weeks of age, and the photograph is attempted with the child held in a sitting position, the head may tilt to either side or drop front or back. Theoretically, if the child is placed flat on the back, the head will tilt to the affected side. In practice this is not true; many of the children will rotate the head to either side. The situation is further complicated by the extremely short neck in infants generally. In view of the fact that torticollis is now being treated while the child is a small infant, a method must be devised which will prove practical.

One of the most troublesome objects to photograph is the palm of the hand of a child between 14 months and 3 years of age. Children in this group cannot supinate the hands sufficiently while the elbows are at the side of the body. This trouble is quite easily overcome by photographing the back of the hand while the child is seated facing the camera. The patient is then placed in a posterior sitting position with the arm drawn up the back until the elbow is flexed at a right angle. In this position the palm of the hand faces the camera without strain and without supination.

Kodachrome Professional Film

Kodachrome Professional Film Type B for use with tungsten light is now ready for distribution. The daylight type will follow later. The film is being manufactured in the most popular cut film sizes for standard cameras. For viewing or for reproduction, Kodachrome produces a direct full-color positive, free from screen pattern and with the extremely fine grain characteristic of the reversal process. Professional Kodachrome provides a practical technique for direct-color photography. It is supplied in boxes of ½ dozen, at the following prices:

2¼ x 3¼	$ 3.90
3¼ x 4¼	5.25
4 x 5	6.75
5 x 7	10.50
8 x 10	21.00
Centimeter Sizes	
6.5 x 9	4.25
9 x 12	6.40

Bell & Howell News

Bell & Howell has announced a substantial price reduction on all 8 and 16 mm. Filmo cameras. Prices also have been reduced on sound and silent Filmo projectors. In issuing news of the price reductions, the company states that no changes in quality or construction have been made in the various listed machines to make the lower prices possible. On the contrary, it is claimed that many improvements in manufacture are included in the reduced prices. Most projector models, for example, incorporate improvements resulting in a 33% increase in the brilliancy of screen images.

Bell & Howell now offers a somewhat lower priced 1″ F 1.5 lens as optional equipment or for replacement purposes. This lens is fully color corrected and accurately calibrated for photographing subjects as close to the camera as one and one-half feet. It is for use on all Bell & Howell 16 mm. cameras. This new lens supplements, but in no way supplants, the regularly furnished Taylor-Taylor-Hobson lens.

The Company also announces a 32-volt 16 mm. silent projector designed especially for those who might use movie equipment in trains, yachts, or summer homes where 32-volt current is employed.

ASSOCIATION NEWS

The President's Address

IT gives me great pleasure to preside over this meeting in the City of Philadelphia. Here I spent ten very fruitful years as a medical artist; and, during the latter part of the period took up biological photography, first, in the Pepper Laboratory, and later, in the then new Medical Laboratories of the University of Pennsylvania. At that time photography was carried on in the biological field by scientist amateur photographers, by professional photographers who did this work as a side-line, and by scientific illustrators who realized that, by acquiring photographic skill, they could materially increase their value to the institutions and to the clients they served as well as enormously to increase their output.

Because I developed a technic in photography in addition to my training in art and illustration, I was first employed occasionally and later offered a full-time assignment by the Rockefeller Institute for Medical Research in New York. There, in charge of the Illustration Division, I served for over twenty-five years.

In Philadelphia are some of my staunchest friends and former colleagues and to return here seems like coming home. As your President, it is my duty to briefly report on the events of the past year and suggest some policies for our future development.

The past year has been a busy one for your officers and directors, and they have faced a number of important decisions. They were confronted a year ago with the problem of securing a new publisher for the Journal as Messrs. Williams & Wilkins had served notice that they were to discontinue its publication. After considerable investigation and discussion of plans, an arrangement was made with a new publisher to carry the Journal *forward!*

It was necessary to make a few changes in makeup and in the type of illustration of the Journal, and the character of the paper, and it is thought that these will constitute an improvement. It is also hoped to accomplish some economies.

The balance of a long-standing debt, assumed in connection with the early publication costs of the Journal, has been liquidated.

In our meetings there have been numerous urgent requests that intensive

efforts be made to increase the membership, and plans are being formulated to bring this about.

The membership does grow, however, automatically, through personal contacts and through readers of the JOURNAL. Our members should urge all interested persons they meet to join us.

For a number of years we have discussed the matter of incorporation, delaying principally because we hoped to find a way that would not involve too high a cost. A committee has the matter in charge. They have a plan and at this meeting a group of members will be elected who will become the incorporators.

The Association has acquired all the back numbers of the JOURNAL, which will be offered for sale singly and in sets. Members who joined too late to get the early numbers will find in them much valuable material.

A number of times it has been suggested that we consider the matter of so organizing our Association as to authorize our members to place after their names letters to indicate Membership or Fellowship in the Association, as is the case in the Royal Photographic Society and the Society of Motion Picture Engineers. This brings up the question of eligibility to fellowship. Usually such a grade calls for certain special qualifications, experience, and contributions in methods or in publication, and the payment of a higher rate of dues. This in turn brings up the subject of our quite mixed membership, and at once we are faced with the question as to whether such a grading of members would be a benefit or a detriment to the organization. If it interests a considerable number, a committee should make an investigation and report its findings and recommendations.

An Association cannot prosper if its members are underpaid and lack appreciation by their employers. The matter of fair compensation is on many minds, even if it is not often discussed. The prices of negatives and prints or lantern slides vary tremendously in different locations and sometimes in the same town. The average buyer is no better informed than some photographers about the value of photographic work, and this is one cause of great discrepancies in price. The requirements vary greatly also, as some clients require a large output and care or know little about quality, being interested only in the cost. This refers as much to work done in institutions having full time photographers as to free-lance photographers serving unattached patrons. There are, also, craftsmen employed half or full time, who are permitted the use of the institution equipment to do outside jobs for non-staff members or

others, and to receive pay for such work. This arrangement is quite legitimate, but those who work under such conditions owe it to others, who are not as favorably placed, not to make their prices so low that they make of themselves unfair competitors. It may be well for us to try to gather by means of a questionnaire, as much information as possible on this situation and pass on to our members a résumé of the results. This may also prove a fruitful subject for discussion in the local chapters.

It is a pleasure to report that in this convention we have received the support of more commercial firms than ever before, and that we count among them some who have not previously exhibited. The renewal of member subscriptions is at least 50 per cent greater than during any previous year. The records show, too, that the list of our sustaining members is growing. This is most gratifying, as one such membership pays into our treasury the same net amount as do eight active members.

I take this opportunity of thanking those technical and supply firms who have so generously supported us, many of them from the beginning. They have helped us by having members of their staff join our Association; they have contributed valuable papers to our programs. When the JOURNAL made its appearance they gave us advertising and some of them are among the sustaining members. We must not forget that without their help in all these respects it would have been almost impossible for us to have maintained our organization, and remembering all this, it is incumbent upon us as individuals to reciprocate the support that they have given us.

We look forward toward the coming year with a feeling of encouragement and optimism.

Thanks are extended to our Philadelphia Committee for their excellent work in preparing and staging this convention and the management of the Warwick for their splendid cooperation. Between them they have put on our best convention.

WHEN the first Convention of the B.P.A. was held in New Haven in 1931, it was attended by a few members mostly from New York and Connecticut; the commercial exhibit boasted of four or five items of equipment furnished by local firms; and the Salon consisted of a few prints and transparencies brought along in the members' pockets. At our 1938 Convention we had members from thirteen states and Canada. The Salon of fine color

and monochrome prints took up more than four hundred running feet of wall space. And we had extensive exhibits of equipment from the following firms:

Defender Photo Supply Co.
Dufay Color Corp.
Eastman Kodak Co.
E. Leitz, Inc.
Meriden Gravure Co.
Spencer Lens Co.
Williams, Brown & Earle, Inc.
Carl Zeiss, Inc.

Our steady growth is encouraging. But our chief source of pride is the continual improvement in quality of our Salon prints. Every year they are better. Our photographers are not turning out the same sort of picture year after year. They are experimenting with new materials; applying their work in new ways and in new fields; keeping pace with the general photographic advances but adapting their medium expertly to their own scientific demands. An association of craftsmen such as this is well worth having.

A brief account of the transactions of the 1938 business meeting follows, with a list of Salon exhibitors.

Business Meeting—1938

Incorporation. According to the laws of the State of New York, a Committee of members of the present B.P.A. must be chosen to become the incorporators of the B.P.A. Inc. Miss Shiras moved that the Officers and Directors present in Philadelphia should become the incorporators of the Association: namely, Mr. Schmidt, Mr. Massopust, Miss Zimmer, Miss Shiras, Mr. Harding, Mr. Creer, Mr. Payne, Dr. Richards and Mr. Morris; and that $100.00 or as much thereof as necessary be appropriated to carry out the incorporation. Dr. Dillman seconded the motion. It was passed unanimously.

Exchange with the Royal Photographic Society of Great Britain. We are on an exchange basis with the R.P.S., receiving their monthly magazine for our quarterly. Mr. Payne moved that a complete file of our Journals be sent them, since this exchange system was only started recently. Mr. Creer seconded the motion and it was passed. The Secretary was instructed to write Mr. Blacklock, the Secretary of the R.P.S. asking what numbers are necessary to complete their files.

1939 Convention. Mr. Morris suggested New York City as a meeting place for 1939 since members could attend the Convention and see the World's Fair in one trip. Miss Shiras invited the Association to Pittsburgh; Mr. Massopust to Milwaukee; and Mr. Creer suggested Chicago. It was the sense of the meeting that hotel accommodations would be very difficult to get in New York next year; that the Fair would probably still be running in 1940 and it might be easier to get suitable accommodations then; and that all in all, Pittsburgh would be the best choice for next year.

It was suggested that the meetings begin on Wednesday, running through Friday, instead of from Thursday through Saturday as at present. Some of the members present were against this plan as it meant being away from their work for nearly a week. The majority at the meeting however were for it. This vote was not taken as a formal motion but as an expression of opinion. The question will be placed before the membership by mail before the final decision is made.

Elections. Mr. Ferdinand Harding presiding, Mr. Ralph Creer, Chairman of the Nominating Committee, read the following report:

President	Mr. Louis Schmidt
Vice President	Mr. William Payne
Treasurer	Miss Stella Zimmer
Secretary	Miss Anne Shiras
Director	Dr. Melvin Dillman
Director	Mr. William Martinsen

Dr. Richards moved the nominations be closed. The motion was passed and seconded. Mr. Massopust moved the rules be suspended and the Secretary be instructed to cast a unanimous ballot for the election of the entire ticket. The motion was seconded and passed unanimously.

Mr. Schmidt, First Life Member of the B.P.A. Mr. Payne rose and said that in view of Mr. Schmidt's services in behalf of this Association, as one of the founders and charter members, Vice President in 1933 and President from 1934 on, he moved that the B.P.A. express its gratitude and sincere appreciation by electing Mr. Schmidt to life membership. Mr. Massopust seconded the motion. It was passed unanimously and with enthusiasm.

Vote of Thanks. Mr. Harding moved a vote of thanks to the Philadelphia Chapter, and to its Chairman, Dr. Dillman, for their most successful handling of the Philadelphia Convention, with all the work entailed.

Mr. Harding moved a vote of thanks to Mr. Clarke for his six years of work on the JOURNAL, often carried on under great difficulties.

Both these votes were promptly and unanimously given.

Editorial Board. Mr. Schmidt introduced Mr. Leo Massopust, Department of Art and Photography, Marquette University School of Medicine, as the new Editor of the JOURNAL, having been unanimously chosen at a meeting of the Board of Directors. Mr. Massopust stated that in accepting the Editorship he had the complete cooperation and support of his institution. He named the following Editorial Board:

Dr. Arthur W. Proetz
Mr. Ferdinand R. Harding
Miss Anne Shiras
Mr. Arthur W. Fuchs

The arrangement and publication of illustrations will be supervised by Mr. Louis Schmidt.

1938 SALON

Prints from the following exhibitors were accepted for the Salon:

American Genetic Association
Haig Dermen
U.S. Dept. of Agriculture
Robert Cook
American Genetic Association
Lilian A. Guernsey

G. A. Busanovich
Germantown Hospital
Philadelphia, Pa.

Carl D. Clarke
School of Medicine
University of Maryland
Baltimore, Md.

C. Graham Eddy
Eloise, Michigan

Emil Forney
Pennsylvania Hospital
Philadelphia, Pa.

John Frank
Jefferson Medical College
Philadelphia, Pa.

Ward C. Hammond
Philadelphia, Pa.

Allen Hancock
Jefferson Medical College
Philadelphia, Pa.

F. R. Harding
Children's Hospital
Boston, Mass.

Joseph Haulenbeck
Rockefeller Institute for
Medical Research
New York, N. Y.

Nathan S. Horton
Ayerts, McKenna & Harrison
Montreal, Canada

Leo C. Massopust
Dep't of Medicine
Marquette University
Milwaukee, Wis.

Stanley J. McComb
Mayo Clinic
Rochester, Minn.

Margaret McDonnell
New York Post Graduate
Medical School & Hospital
New York, N. Y.

Louis Miller
Welfare Island
New York, N. Y.

R. H. Peckham, Ph.D.
Temple University School
of Medicine
Philadelphia, Pa.

Rehman Irving
College of Dentistry
New York University
New York, N. Y.

Miss Ritchie
Skin & Cancer Unit
Post Graduate Hospital
New York, N. Y.

Frank N. Ruslander
Harper Hospital
Detroit, Mich.

Albert Sadler
St. Vincent's Hospital
New York, N. Y.

Louis Schmidt
Rockefeller Institute
for Medical Research
New York, N. Y.

Aaron Stephenson
University of Pa.
Hospital
Philadelphia, Pa.

William J. Taylor
Temple University Hospital
Philadelphia, Pa.

Technigraphic Institute
30 N. Michigan Ave.
Chicago, Ill.

C. S. Tuttle, D.D.S.
1411 Walnut Street
Philadelphia, Pa.

Herbert Warren, M.D.
Hahneman Medical College
Philadelphia, Pa.

Lewis Waters
Dep't of Medical Art
College of Medicine
Baylor University
Dallas, Texas

Stella Zimmer
College of Medicine
Syracuse University
Syracuse, New York

If we have omitted any exhibitors here, it is because their prints were withdrawn before the Salon was taken down and the final listing made.

The Eighth Annual Salon now becomes our 1938 Travelling Salon, available to members for the cost of transportation one way. It is especially suit-

able for hanging at scientific meetings, large institutions, etc. To obtain it please write to Mr. Louis Schmidt, Rockefeller Institute for Medical Research, New York, N. Y.; or to the Secretary.

The first stop for the 1938 Travelling Salon was Pittsburgh, where it was hung at the first meeting of the Pittsburgh Chapter, on October 5th.

Biological Photography in New Zealand

Early last summer our first member from New Zealand joined the Association. This was Mr. J. G. Howard, of the Medical School, University of Otago, Dunedin. Mr. Howard writes as follows about the use of scientific photography in his country:

"Of course there are less than two million people in New Zealand, so that there are no very large hospitals and only one medical school. This means that (as far as I know) there are no people here engaged solely in biological photography. Those who do engage in it are, like myself, really doing it as a side-line from their other work. I am the Histological Technician here primarily. Besides that, though, I do a fair amount of museum work, modelling, photography, and teaching of histology as a demonstrator in the practical classes. . . .

"I am trying to work up color-photomicrography as an aid to teaching histology. I photograph specimens which are hard to demonstrate to a class of about 90. The beauty of the Finlay process is that you can take a monochrome print on which you can mark the various pertinent points, and exhibit it on the viewing box alongside the autochrome which shows the specimen in its natural colors as it appears under the microscope.

"Outside of this, photography in this department is mainly used for record purposes. I should think that we do more photography than any other department in the school, though I think there should be enough in all departments of the medical school and the hospital to keep a man busy full time.

"Motion pictures are used quite extensively, especially in surgery, bacteriology, public health and orthopedics. We have only two films in our department because our subject is not one that lends itself to the making of films. The films we use were not made on the premises but are commercial ones from Kodak, etc. They are making some attempt at present in the Public Health Laboratories to produce a propaganda film on the prevention of Hyda-

tids. . . . I think that our department is the only one in which autochromes are being used though lantern slides are extensively used in other departments. We do most of our teaching from wall diagrams of which we have had about 6000 made in the department by our artist."

Theories on Artefacts

Our requests for solutions of the mystery of the strange markings on lightning pictures published in the September number, 1938, by Mr. C. Agostini has brought several responses. One correspondent writes all the way from Budapest to assure us (in English, fortunately) that:

"The 'ghosts' in Mr. Agostini's lightning shots . . . are typical for a microscopically small hole in the bellows of his camera. This hole acts as a picture-building element in the way of the well-known 'camera obscura' and it has very nicely pictured some of the lamps burning in his room upon the emulsion. . . . I don't know if the Argus has any bellows as I don't know this camera, which is obviously an American made affair. But if there is no bellows there is a hole somewhere else. That's a sure wager. In the third picture Mr. Agostini has moved around the camera for a longer time before getting his setup and therefore he got those longer streaks which at the same time indicate the direction in which he moved his camera. . . ."

In order to cover all possibilities, our correspondent took pains to investigate the "American made affair" and adds a P.S.:

"As I just hear the Argus has no bellows. The hole must be in the camera body or in the tube extension for the lens, possibly between tube and body. Perhaps a small screw has fallen out somewhere."

Since Mr. Agostini has used his Argus under a variety of circumstances, it seems as though a hole (even a "microscopically small hole") would have affected some of his other shots, which is not the case. Therefore a theory that links the markings with the lightning itself seems more plausible. Dr. Laurance Redway suggests that the marks represent a discharge of static electricity across the film. The highly charged air seems to have found a conductor in the body of the camera and to have exposed the film in its path. Any workers who have used a hair-brush to dust off the old-time photographic plates have seen similar markings.

Albums

The Association announces with pleasure the acquisition of a new Album, compiled by Mr. Adolph Marfaing, Photographer of the Columbia University Institute of Ophthalmology, showing methods of photographing the anterior eye. Anyone familiar with our Salons knows the fine quality of Mr. Marfaing's photographs. This book will be a valuable reference work, not only to specialists in eye-photography, but also to the photographer who has only an occasional eye-picture to make and so has no satisfactory standard procedure worked out. The Album is available to members for the cost of transportation one way, and may be had by sending a request to Miss Florence Melvin, Kinsman Hall, Ohio State University, Columbus, Ohio; or to the Secretary.

Other Association Albums describe the photographic methods used by the Rockefeller Institute for Medical Research, New York City; and by the Rockefeller Institute for Plant Research of Princeton, N. J. Each of these volumes contains, besides a number of fine prints, a complete description of equipment and technic.

Laminagraphiana

Our member Mr. Jean Kieffer's invention, the x-ray laminagraph, keeps him so busy that we no longer see him nor hear from him as much as we should like. An item in the *Hartford Courant* gave us some information on his invention we had not heard before:

"The laminagraph whose existence has only recently been announced has already attained national prominence by its discovery of the cause of Paul Dean's pitching collapse. It disclosed a stray bone in his shoulder joint, and now an outstanding National League pitcher may be restored to the St. Louis uniform."

Here is fame indeed! More extended uses for the new machine are given in the same article in a statement made by Dr. Stephen J. Maher, Chairman of the Connecticut Tuberculosis Commission:

"Aside from the immensely improved aid in diagnosing lung, bone and glandular tuberculosis, which is provided by this new key to bad cases of cavitated lung tissue, the laminagraph comes as a timely and direct aid in cases of accident. It is easy to see how it may aid in tracing quickly and accurately the puzzling path of a bullet wound, in making it possible to check hemor-

rhage, say, of the abdomen and in giving a surgeon the correct angle in getting rid of a suppurating blood clot and in disclosing in what relation to some rib or some other anatomical part any object is. In other words, the new x-ray machine throws new light on the location of any foreign body."

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The Royal Photographic Society of Great Britain, at its annual exhibition, September 10 to October 8, 1938, accepted and hung prints contributed by these members of the Biological Photographic Association:

Busanovitch, G. M.—Philadelphia, Pa. 5 prints
Fuchs, A. W.—Rochester, N. Y. 5 prints
Lown, W. C.—Boston, Mass. 2 prints

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E. Leitz Co.,
New York, N. Y.

The Fleischmann Laboratories,
New York, N. Y.

Louis Paul Flory,
Boyce Thompson Institute for
Plant Research,
Yonkers, N. Y.

Leonard Perksie,
Defender Photo Supply Co.,
New York, N. Y.

Louis Schmidt,
Rockefeller Institute for
Medical Research,
New York, N. Y.

George H. Semken, M.D.
16 West 85th St.,
New York, N. Y.

Anne Shiras,
University of Pittsburgh
Medical School,
Pittsburgh, Pa.

H. W. Zieler,
E. Leitz Co.,
New York, N. Y.

Report of the Committee on Motion Pictures

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BAKER, Prof. C. L., Southwestern University, Memphis, Tennessee.
Kodachrome pictures of Reel Foot Lake: birds, fishes, snakes and turtles.

BRUNER, Dr. J. M., 1005 Bankers Trust Bldg., Des Moines, Iowa.
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K. K. BOSSE
JEAN KIEFFER
OSCAR W. RICHARDS, *Chairman*

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Shriram Deshaprabhu (*R. P. Creer*), Tata Memorial Hospital, Bombay, India
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E. E. Glenn, M.D., Medical Arts Building, Springfield, Mo.
Arthur Gray Guyer, Hanover, N. H.
Morris A. Hershenson, M.D. (*Pittsburgh Chapter*), 3401 Fifth Avenue, Pittsburgh, Pa.
William Huber, M.D. (*Pittsburgh Chapter*), Jenkins Arcade, Pittsburgh, Pa.
Wayne M. Hull, M.D., 800 N.E. 13th Street, Oklahoma City, Okla.
Benjamin Klein, Klein and Goodman, Philadelphia, Pa.
Eugene V. La Clair, 215 Medical Arts Building, Roseburg, Oregon
Earle B. Perkins, Ph.D., Dept. of Bio-Photography, Rutgers University, New Brunswick, N. J.
Mary Preston Clapp (*David Skelton*), Meadowbrook Hospital, Hempstead, Pa.
L. D. Redway (*Louis Schmidt*), Ossining, N. Y.
John Spurbeck, 41 Raleigh Street, Rochester, N. Y.
Edwin J. Stedem, M.D. (*Ralph Creer*), 395 East Broad St., Columbus, Ohio
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who have already filled their quota of "one new member for every old," since the Directors' meeting in Philadelphia. We realize that in starting to list our quotas as of the Convention date, we leave out many old members who have brought in members in the past, but we hope we may be listing them soon again under the present quota. The member bringing in more than one new member will have asterisks printed after his name indicating the number brought in.

If you do not know a prospect personally, but know of one, send us the name and we will contact him, crediting him to you if he comes in.

News about the uses of photography in science; news from and about our members is welcome. Let us hear from you.

ANNE SHIRAS, *Secretary*
University Office
Magee Hospital
Pittsburgh, Pa.

*

The first of a series on processes of printed reproduction, "The Full-Tone Collotype Printed Reproduction," may be found in the JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION, Vol. 1, No. 2, December 1932. The object of the paper is to give the biological photographer a working knowledge of the various processes of reproduction. In summary, the purpose has been to point out that to obtain the optimum in printed reproductions, too much care cannot be spent in the preparation of the original which is supplied to the printer; to acquaint the reader with a few of the factors which must be present in a process suitable for facsimile reproduction, and that Collotype is endowed with these factors and is not costly.

This article is of particular importance to our readers, since this journal is now using the Collotype method of reproduction.

FULL-COLOR DUPLICATES NOW POSSIBLE FROM 16 MM. KODACHROME MOVIE FILMS*

USERS of 16 mm. motion picture cameras, either silent or sound, can now have their Kodachrome reels duplicated in full color, and in a quality comparing favorably with the originals, the Eastman Kodak Company announces from Rochester, New York.

Technical details of the duplicating process have been worked out at the Kodak laboratories in Rochester, and for the present all duplicates will be made there. Modestly priced, the duplicates will cost only a fraction more than an equivalent length of unexposed 16 mm. Kodachrome Film.

Advantages of duplicating Kodachrome movie reels in the full color of the original will be apparent in many fields. Heretofore, a Kodachrome movie has been limited to the color original and black-and-white duplicates. Now, a valuable original reel can be duplicated and stored, the full-color duplicate being used for everyday projection.

Any number of duplicates can be made from a chosen Kodachrome reel. This facility will be of particular value in the production of commercial and educational motion pictures, where a number of copies of one film must be available for widespread, simultaneous distribution. Use of duplicates makes this possible at small cost, and at the same time eliminates risk of damage to the original, which often could not be retaken.

All editing of the film can be done before it is sent in for duplication. Special effects in the original, such as fades, wipes, and lap dissolves, also appear in the duplicate. However, if these effects are not present in the original, they cannot be inserted during duplication.

When a silent film is to be duplicated, only the film need be sent to Rochester. But, when a sound film is sent in for duplication, the maker must include a 35 mm. or 16 mm. matched positive print of high quality—either variable area or variable density—and must indicate clearly and accurately the proper starting points on both the sound track and the 16 mm. original.

* Received for publication November 16, 1938.
Editorial Service Bureau, Eastman Kodak Co., Rochester, N. Y.

Prices for the full-color duplicates from 16 mm. Kodachrome Film are:

	Silent	*Sound*
Orders for 77 to 100 feet	$10.00	$12.50
Orders for 100 ft. or more, per ft.	.10	.12½
Orders for less than 77 ft., per ft.	.13	.16¼
Minimum charge	6.50	8.15

Editor's Note:—This announcement was considered very important to the readers of this journal. Hence, due to its late arrival, and in order to eliminate any major changes in the arrangement of the journal, it was placed in this position.

FIGURE 1. "Oh Yeah!" From the 1937-38 Biological Photographic Association Travelling Salon. These birds will shortly leave the nest.

UNIV. OF MICH.

The Journal of the
Biological Photographic Association

Volume 7 March, 1939 Number 3

AN INTRODUCTION TO ORNITHOLOGICAL PHOTOGRAPHY

NATHAN S. HORTON*

THE opening paragraph of most papers is usually the most difficult, particularly when the paper is not on a purely technical subject where one may start with little or no preamble. In submitting this paper to the JOURNAL it was my thought that biological photographers would be interested in an "extramural" activity that is fundamentally photographic—an activity that can be "taken as desired" or developed into a highly technical study, depending entirely on individual tastes. Ornithology is a very broad subject on which many workers have spent a lifetime of study; so in this paper I will limit the discussion to generalities.

My first contact with this work was purely accidental. Having, for several years, spent vacations rambling along the coast of Maine I gradually began to realize that the bird life offered a rich field for photographic study. Each year more and more film was used in photographing herring-gulls, terns and cormorants and, consequently, interest in the subject from the technical standpoint increased in proportion to the number of exposures made. Although several trips were made by car to various locations along the mainland, and by boat to certain islands, "headquarters" was usually considered as being Popham Beach, a comparatively little-known section of the coast. Prior to starting out

* Received for publication January 18, 1939. Ayerst, McKenna & Harrison, Limited, Rouses Point, N. Y.

on my 1938 trip it seemed that the photographic possibilities of Popham were about exhausted, but a fortunate meeting with Mr. Ralph Palmer of Cornell University brought to a head the interest in ornithology that had been developing for several years.

Ornithological photography does not, after all, mean that one must make a deep study of ornithology, but the few days spent with Palmer convinced me that a certain amount of technical knowledge was highly desirable. Palmer[1] has, for several years, made a study of birds found along the Maine coast. His notes are voluminous and his remarkable photographic records are convincing evidence of the value of photography in ornithology. With him, photography is an adjunct to his work—a means to an end—but to the average person the technical knowledge serves as the adjunct to the photography. Just as a knowledge of medicine aids the biological photographer, a technical knowledge of ornithology improves, and adds to the interest of, the photography of birds.

One factor which makes this type of photography so fascinating is the conditions under which the work is done; whether it be the seashore or the woods one is out in the open and as a usual thing, particularly with marine bird life, photography under such circumstances is highly enjoyable. The coast of Maine, in my opinion, constitutes one of the most beautiful spots in America. Unfortunately, many sections are thickly populated by summer residents, but there are many locations along the coast that are dotted with small islands and it is on these islands that the ornithological photographer finds a literal paradise. It does not seem possible that any photographer could resist such subjects as the graceful flight of herring-gulls and cormorants and the amusing actions of these marine birds.

My efforts prior to the summer of 1937 were confined to shooting endless feet of film in the Leica with results that were mediocre, to put it mildly. I did not fully realize, until the 1938 "footage" was developed, to just what extent my friend Palmer had changed all this, for his advice had enabled me to gather photographic material entirely overlooked in former years. For several years he has maintained two blinds on one of the small islands off Popham. These blinds are simply crude frame-work covered with burlap, with holes just large enough to permit the lens of the camera to point through. Thus the hole in the burlap covering permits the occupant to see out, a means of observation, while the birds cannot see anything to disturb them. When we

[1] Palmer, Ralph S., Tern mortality along the Maine coast, *Bird-Banding*, 9:117 (July), 1938.

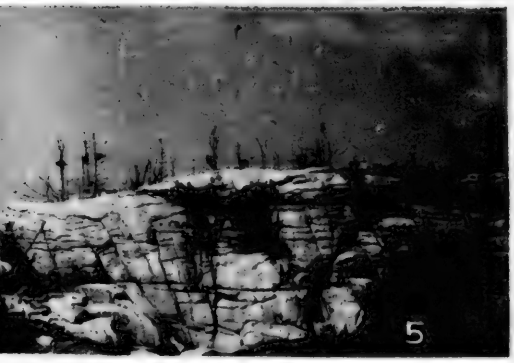


FIGURE 2. Young Cormorants. These birds are younger than those illustrated on the full page.
FIGURE 3. Terns. Taken from a blind.
FIGURE 4. Female Tern returning to nest.
FIGURE 5. General View of island. Taken from canoe.
FIGURE 6. Cormorant nests. FIGURE 7. Fish hawk.

landed on the island the birds would of course leave, but soon after we were settled in the blinds, a matter of anywhere from ten to twenty minutes, they began to return. When these blinds were first placed on the island the birds were rather wary for a time, but soon became accustomed to them, even when within a few feet of the nests.

As some indication of the interest with which one is repaid for spending hours in the cramped quarters of a blind, just consider this one incident. Earlier in the season, when the eggs were being hatched, many nests in a semicircle around the blinds were numbered in order to keep a "clinical" record. On one occasion a herring-gull's egg, which is considerably larger than a tern's egg, was removed from a gull's nest and immediately placed in a tern's nest. In due course of time the birds settled on the island again and this particular tern came back to her nest. Not suspecting that anything was wrong she tried to climb up on the large egg, with the most ludicrous results. Time and time again she would climb onto the top of the egg only to fall off, and then back on again, squawking what was probably the equivalent of Anglo-Saxon curses. This is of course the humorous side of the subject, but it demonstrates the interest with which one is repaid for a little effort. These terns fight fiercely among themselves, figure 3, and some of the "by-plays" cause the time to pass very quickly, so much so that it is very easy to be caught by the tide. The herring-gulls[2,3] are much more difficult to study as they seem to be far more wary of human life on the island; the blinds do not seem to deceive them as they do the terns and therefore a good telephoto lens, rather than a blind, is indicated.

Some of the best subjects were found on a rocky island on which there were many cormorants. This island is seldom disturbed by humans; the cliffs are steep, and a light canoe that can be easily lifted onto a ledge is practically a necessity. Figures 5 and 6 show a general view of this island; the gaunt-looking "sticks" that appear at the top of the island are the remains of trees killed in a storm several years ago. Each tree has anywhere from three to ten huge cormorant nests, and it certainly is a most peculiar and rather awe-inspiring sight when one approaches the island—my first impression was that of some fantastic prehistoric setting that a Hollywood director might conceive.

These cormorants are particularly graceful in flight. Being a rusty-black color, their appearance is not as attractive as that of the herring-gull, but they are intensely interesting even to one who knows practically nothing about

[2] Wachs, H., *Photographie und Forschung*, March, 1937.

[3] Ibid., Dec. 1935.

ornithology. The average cormorant family consists of from three to five young and because of their size, appear to remain in the nest much longer than other marine birds. When we landed on this island the adults, of course, took to the air, but unlike gulls and terns did not continually circle around overhead. Most of them settled on the water keeping well away from the island and this makes photography a little easier, for swarms of birds flying overhead are not particularly conducive to concentration. The first time we visited this island early in the summer most of the nests contained young, varying in size from practically newly born to youngsters who, when we brought the cameras too close, would gather enough courage to leave the nest for their first trip. These birds provide really wonderful photographic subjects. At first they will make quite a fuss, but if one backs away slightly they will then pay no further attention. "Family portraits" can be easily made, figures 1 and 2, and these are most amusing because of the most peculiar, almost grotesque, expressions. On one occasion there was a female who refused to be frightened away permanently and would always return to the nest, figure 4, which unfortunately was on top of the largest tree some fifteen feet above the ground. We photographed this bird for over an hour for it certainly is a rare sight and worth all the trouble that one goes to, to get one good shot of a cormorant alighting on the limb of the tree. These birds have a large wing spread and as they come down with terrific speed they gradually spread their wings to alight on a branch as gracefully as any swallow.

The young birds just about ready to leave the nest are illustrated in figure 1 and this picture is, to my mind, worth weeks of effort, although I must confess it was one of those fortunate shots which required but little work. These birds seem to be continually quarrelling among themselves and my records contain many pictures made from this same camera position. It should be mentioned that no blind was used on this island for the young cormorant thinks twice before leaving the nest in the tree, whereas the young gull can simply run from the nest and return later.

It should be appropriate to mention several "do's" and "don't's" regarding ornithological photography:

1. When landing on an island do not rush madly around with a camera. Go directly to the blind and then keep absolutely quiet until the birds return.

2. If you do not use a blind, try to avoid disturbing nests. The mortality of marine bird life in Maine is rather high, and is unquestionably due, in a large measure, to the invasion by humans of the breeding places.

3. Make full allowance for the tide. It is not very pleasant to have to wait until a Coast Guard or a passing lobsterman sees you.

4. Watch out for poison ivy. Many islands, as well as the mainland, are plentifully cursed with a heavy growth.

5. Take along a small first-aid kit.

6. Make certain that your camera is thoroughly protected from salt water when transporting it by boat. Use a waterproof wrapper.

For those who are interested in the photographic technique it seems quite logical to say that this is a matter more or less up to the individual. However, it has been my experience that the Leica presents the best solution to the difficulties of bird photography. The telephoto lens is a prerequisite; my own equipment consists of the 50 mm. f:2 lens and a 90 mm. f:4. There are many occasions when the 13.5 centimeter lens is preferable, but this is getting into fairly expensive equipment. When working in a blind a 2″ lens will, under most circumstances, be found ideal. On a bright day with fast film focus on an average distance from the blind and then, by stopping down in accordance with your meter readings, further focusing will be unnecessary. This, of course, applies to occasions where a great many pictures are to be made and it is obviously better to focus on each occasion if time permits. Fast film is an absolute necessity, in order to obtain depth of field with a high shutter-speed. The lighting is very brilliant; in fact one can hardly believe the meter readings on the islands on a bright summer day. Using Agfa Supreme at a Weston setting of 64, a great many of these shots were made at anywhere from a 200th to a 500th of a second—at an average of around f:9. There were even many occasions on which I wished that my Leica had been equipped with a 1000th of a second shutter-speed, for even a 500th of a second does not stop motion if the birds are too close. Filters are also necessary when photographing birds against the sky. When cormorants are the subject, no filter is necessary because of the dark color of the bird, but it is a very distinct advantage to use a medium yellow filter in the case of the white herring-gulls and terns; a red filter is seldom necessary.

When photographing birds on the water a Pola-screen is often an advantage in order to eliminate glare. When using Kodachrome the Pola-screen is often of definite value in increasing contrast between the blue sky and white gulls, as it deepens the blue of the sky without affecting other color values.

Although the above paragraph indicates a decided preference for the Leica, it should be borne in mind that this is purely a personal preference. Many naturalists use reflex type cameras; others 3¼″ x 4¼″ plate cameras. If you are at all interested in this phase of photography do not let lack of equipment deprive you of this most enjoyable photographic activity, for "Where there's a will there's a way."

A PLASTIC TRICK FILM OF EMBRYOLOGICAL DEVELOPMENT

HANS ELIAS, PH.D.*

IN teaching biology, I observed that it was very difficult for many students to understand the most basic embryological processes, and I tried to explain these and to give the students a really clear idea by showing drawn plates and other microscopic preparations. But I soon perceived that this method was not sufficient, and, as other teachers have observed, I noticed that the students understand much better when they see the teacher drawing before their eyes on the blackboard and then copy the same drawings in their notebooks. If the students understood the development of the embryo, I directed them to place the single drawings in their natural order, and then, to repeat the drawings of the single stages of development from memory. In this manner most pupils, it seems, gained a fairly clear conception of the embryo's development. But I made still another test: I asked the students to draw intermediate stages between each two successive stages previously drawn by myself. However, at this point I saw that most students, who seemed to have completely understood the process in question, were unable to draw them. There were perhaps 10 per cent of the students able to draw these intermediate stages. Those who could repeat my diagrams had evidently only mechanically memorized my words and drawings.

It was clear that for complete understanding of such intricate changes as the embryological development of a vertebrate, fixed pictures and fixed preparations were insufficient. Some of my colleagues told me that it was not necessary for all of the students to understand the embryological development but that it was sufficient when those students who were especially gifted in biology understood it. However, I believe that a conscientious teacher must try to have all his students comprehend the subject matter he teaches.

The only way to attain real comprehension for this intricate development is by the motion picture film. A microscopical accelerated film was made of the frog's egg after the method of Kopsch and Vogt for scientific research. I knew

* Received for publication January 3, 1939. København-Skodsborg, Høje Skodsborg, 20, Danmark.

beforehand that such a motion picture would not be adequate to give a clear idea of segmentation and development of the neural tube. Furthermore, it would be inadequate to render comprehensible all the internal processes, such as: the formation of the blastocele, figures 4 to 12; gastrulation, figures 13 to 18; or the invagination of the yolk-cells, figures 13 to 16; the gastrocele receding from the blastocele, figures 16 and 17; the entrance of the yolk-stopper of Rusconi, figures 17 and 18; the formation of the neurenteric canal, figures 18 to 20. All these processes and others not mentioned cannot be observed in normal motion pictures taken from the living subject because they show only the surface of the embryo. Also, they cannot be explained completely by a drawn trick-film which would show only the developing median section for the embryo is a three dimensional object and it develops in all directions.

Thus I decided to modify the pictures taken from the subject by a trick-film of plastic models made in the same manner as my film on the development of the flowers of Atropa belladonna and Allium fallax.[1] This film dealt with a true reconstruction of a process which could not be filmed directly, because it occurred in the interior of the bud. A plastilin model of the initial stage was formed, and gradually transformed.[2] First the whole undivided egg, figure 1, was formed and then the first division was complete, figure 2. One of the daughter cells was removed, figure 3, to render the internal development visible.

The various stages in development were executed by using many preparations, wax-plate models, natural motion pictures and the observations of W. Vogt as a basis.[3]

The film "Evolutio ovi Amphibiorum" was made in the Photographic Institute of the Federal Polytechnic School in Zurich. It is regularly used in teaching embryology, and was awarded a trophy at the International Competition for Scientific Cinematography in Como, 1936. It is the property of the "Schweizerische Arbeitsgemeinschaft für Unterrichtskinematographie," SAFU, Zurich, which also has it for sale.

The film contains: Segmentation, gastrulation and formation of the neural

[1] Elias, H., Entwicklungsgeschichtliche Trickfilme . . ., *Ber. fr. Vrg. Pflgeogr. u. syst. Botanik*, Fedde, Rep. Beih., LXXI, 1933; Sur le developpement des fleurs, C. R. Ass. Doc. Phot. et Ciném. Sciences, II[e] Congrès, Paris, October 1934.

[2] The method is described in my publications: Plastischkinematographische Rekonstruktion embryonaler Vorgange, *Arch. Exp. Zellf.*, 19, 1937, and *Anat. Anz.*, 83, Ergh., 1937.

[3] Vogt, W., Gestaltungsanalyse am Amphibienkeim mit ortlicher Vitalfarbung, *Roux' Arch.*, 106 (1925), 116 (1927), and 120 (1929).

tube shown by microscopic, accelerated pictures in Amblystoma mexicanum, Bombinator pachypus, Hyla arborea and Rana esculenta, plastic reconstruction of the developing egg of Hyla arborea, plastic reconstructions of the developing brain in Rana esculenta.

Explanation of the Figures.

Plastic models of the film "Evolutio ovi Amphibiorum."

Figure 1. The whole undivided egg of a tree-frog four hours after fertilization.

Figure 2. Two cell stage median vertical division.

Figure 3. Four cell stage transverse vertical division.

Figure 4. Eight cell stage horizontal division; the first trace of the blastocele is visible.

Figure 5. Sixteen cell stage radial vertical division.

Figure 6. Thirty-two cell stage latitudinal division.

Figure 7. In this stage the small upper cells continue to divide at the original rate while the larger lower cells, rich in yolk, are dividing more slowly. In the polar cell circle the cells are dividing tangentially, in the second and equatorial circles the cells are dividing radially.

Figure 8. The next division occurs in the opposite way: Radial division of the cells of the polar circle, tangential division of the cells in the second and third circles. The developing egg now has two layers of cells. The embryo has the appearance of a mulberry and is said to be in the morula stage.

Figures 9–11. More advanced stages of morula. The divisions occur at 13° C. at intervals of 40 minutes. At lower temperatures the process is slower. At higher temperatures it is faster. At 4° C. it is completely arrested and the embryo may be kept for several weeks by refrigeration. Normal development is restored when the temperature is again increased.

Figure 12. After 24 hours the cells are greatly multiplied and become microscopically small. This stage is called blastula.

Figures 13–15. Now the gastrula stage begins with the invagination of the yolk-ladened cells, in the form of a cylindrical cone. This is the first indication of the digestive tract.

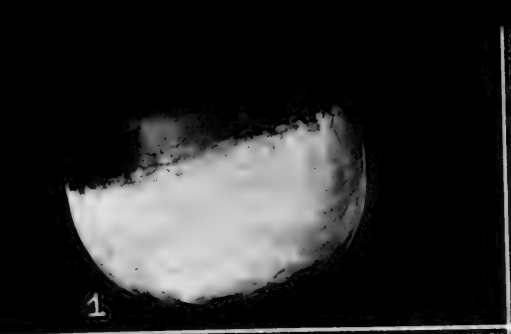
Figure 16. This invagination enlarges, obliterating the original segmentation cavity, the blastocele.

Figure 17. A small portion of the gastrocele remains and may be seen below the newly formed archenteron, the gastrocele.

Figure 18. Invagination has been completed, and on the dorsal surface of the embryo, a groove bordered by two folds is forming. This is the beginning of the nervous system.

Figure 19. The folds rise higher and higher and tend to meet in the median plane. The embryo is also increasing in length.

Figure 20. The folds continue to fuse, converting the groove between them into a tube, the neural tube. This represents the beginning of the formation of the brain and spinal cord.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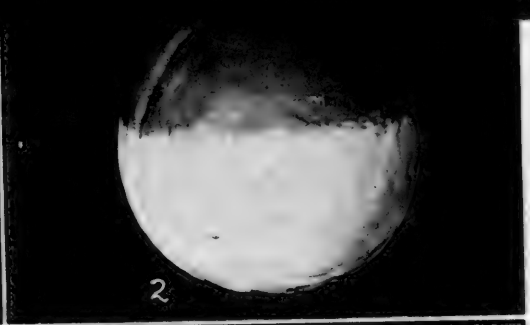
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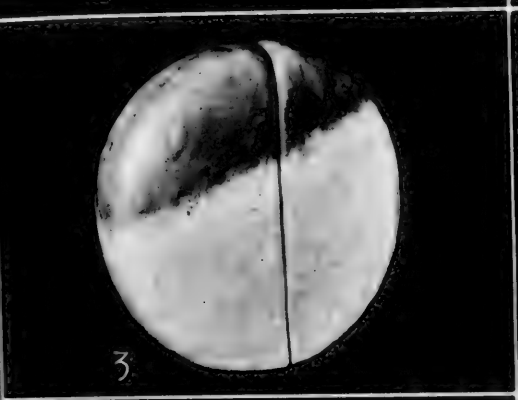
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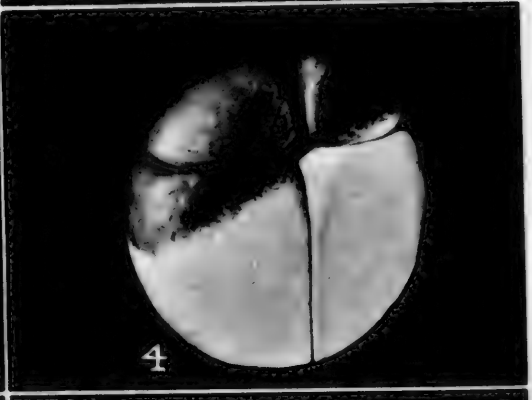
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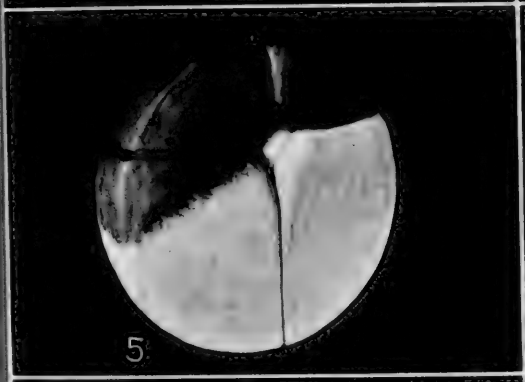
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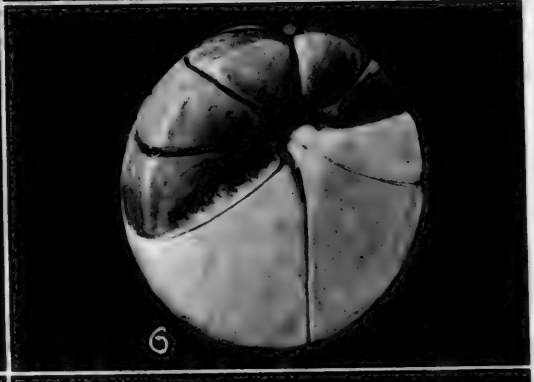
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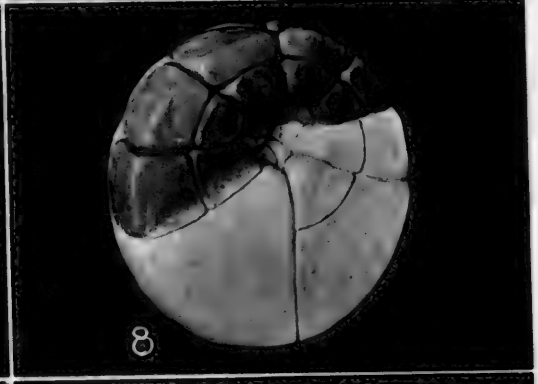
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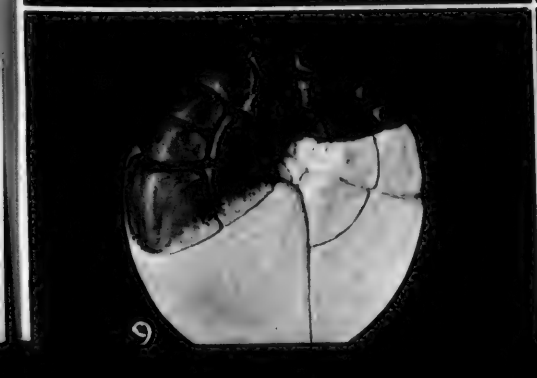
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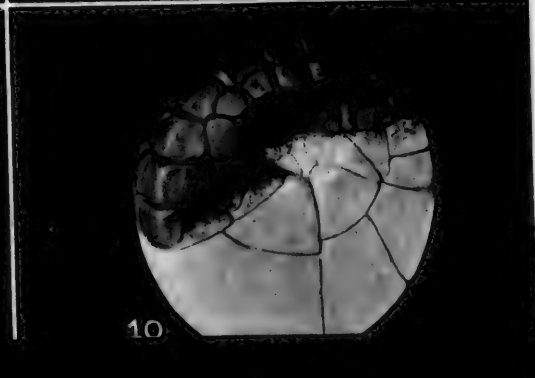
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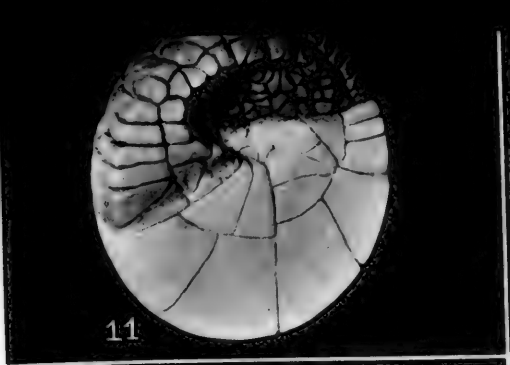
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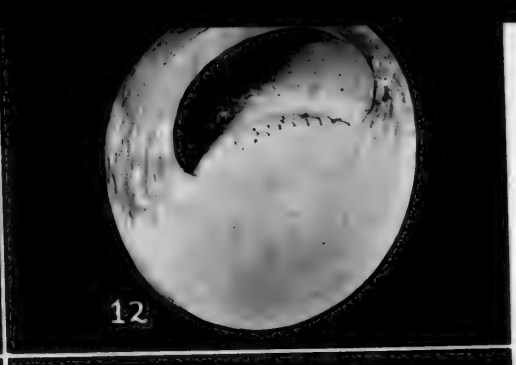
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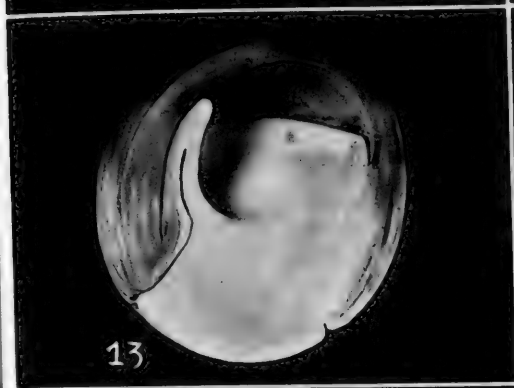
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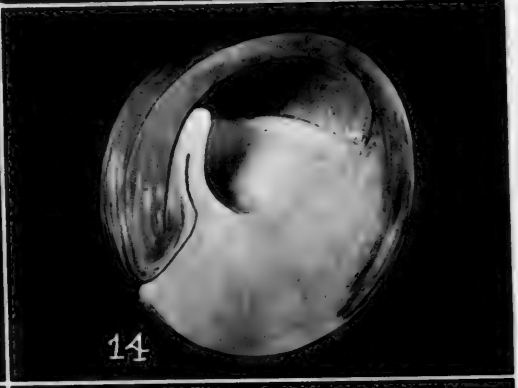
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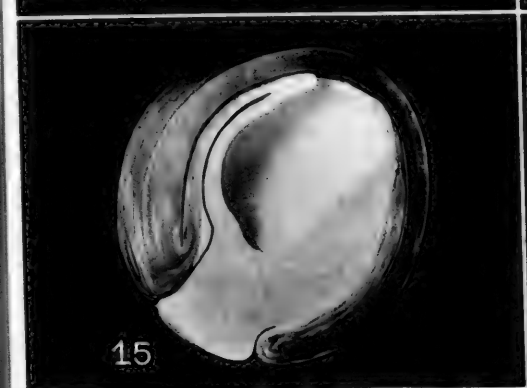
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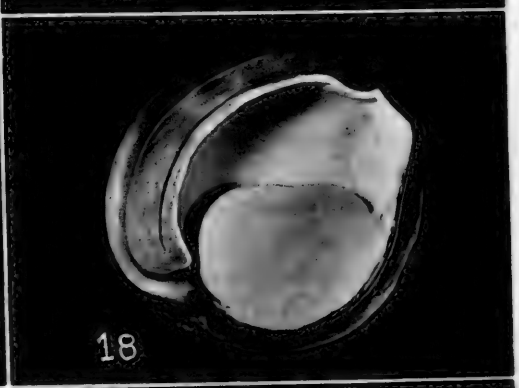
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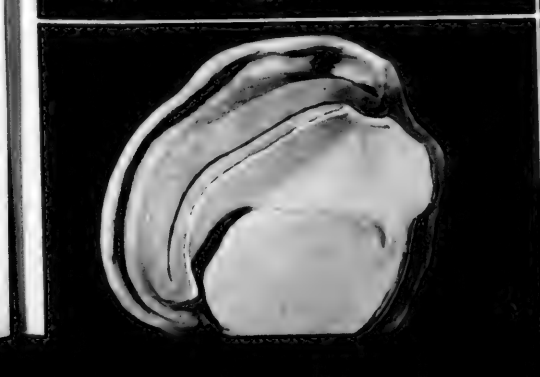

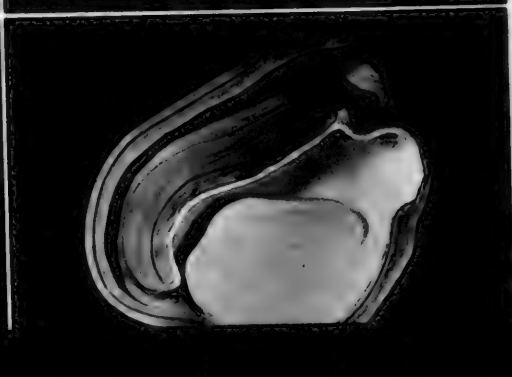

UNIV. OF MICH.

NOTES ON THE CONTROL OF PHOTOGRAPHIC DETAIL

G. M. BUSANOVICH, A.R.P.S.*

IN technical and scientific photography, it is usually essential to reproduce all the recordable detail of the subject in the negative and in the final print. In many cases it may be necessary to sacrifice some detail to obtain some other, finer and more significant detail. In any case, a knowledge of the governing factors is helpful in securing the ultimate effect desired. In pictorial photography, too much detail may distract the attention from the general theme of the picture, but even here it is best to reproduce as much as possible on the negative and to depend upon the printing process or subsequent treatment of the print to suppress whatever may appear to be excessive and obtrusive. Such a procedure permits better control of the resulting print. It is a general objective in photography, therefore, to record all possible detail in the negative.

Lack of detail in the negative may result from all, several or any one of the following causes:

1. Partial spectral-insensitivity of the emulsion.
2. Incorrect exposure.
3. Incorrect contrast.
4. Fog.
5. Grain of the negative.
6. Halation, marks, spots, etc. (local loss of detail).
7. Poor definition or unsharpness.

1. Partial Spectral-Insensitivity of Emulsion

Films may be classed as non-color-sensitive, orthochromatic and panchromatic. The non-color film is sensitive only to ultra-violet, violet, blue and blue-green, and is accordingly totally unfit for the photography of objects containing any other colors. No matter how much the exposure is increased, these films will not show detail in the green, orange and red fields. This type of film is the only kind recommended for reproduction work of subject matter

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containing only black and white and gradations of black to white, such as photographs, radiographs and charts. It is not suitable if any other color is included.

Orthochromatic films are excessively sensitive to blue and violet, sensitive to ultra-violet, slightly sensitive to blue-green, and have a secondary maximum of sensitivity in the yellow-green, a slight sensitivity to orange and none to red. They are exceptionally good for subjects containing mainly blue and yellow-green although, if good detail is desired in the blue, a yellow filter must be used to absorb the ultra-violet and some of the excess blue. Orthochromatic films are better than panchromatic for the photography of skin lesions that are not too predominantly red; in such cases panchromatic film does not show enough differentiation between the yellow and the lighter shades of red.

Photographic films are supplied in grades capable of reproducing various degrees of contrast; the grade to be used depends upon the contrast desired under the existing conditions. Orthochromatic film is sometimes recommended for the photography of medical specimens. Many specimens, however, contain a considerable amount of red; these should be photographed on a film sensitive to this color—commercial panchromatic or process panchromatic film, depending upon the contrast in the subject and lighting, figures 1 and 2.

Panchromatic films are sensitive to green, orange and red light, just as the eye is, but are also inordinately sensitive to the blue, violet and invisible ultraviolet light. With artificial light, however, except mercury vapor and enclosed arc, the highly actinic rays are weak, and the results shown by panchromatic material over the other films are much superior. To obtain correct tonal reproduction, filters must be used for either artificial light or daylight. "Orthochromatic filters," K-2, X-1, X-2, etc., are used when it is sought to reproduce the object as it actually appears to the eye. Another type, called contrast or detail filters, Wratten A, B, F, etc., have the effect of greatly exaggerating the tonal contrast between several colors, or increase some fine detail in one or two colors at the expense of detail in the others. For instance, if a subject containing red, yellow and white is photographed, and the differentiation between the red and white is to be as sharp as possible, the subject should be photographed on a panchromatic film with a blue filter to intensify the blackness of the red as recorded in the print. Thus if it is desired that detail in a certain color should appear especially black in the print, it should be

photographed in its absorption band, that is, through a filter complementary to the color of the subject. If, however, exceptionally fine detail is desired in one color, with no importance attached to detail in the other colors, the material should be photographed in its transmission region, that is, through a filter of the same color. For example, a red filter should be used to photograph detail only in a predominantly red subject.

Again a choice must be made with regard to a wide range of reproducible contrast. Panchromatic film may be the correct choice, and the proper filter may be used for a certain subject, but the result may suffer from poor detail because a grade of panchromatic film of too low contrast has been selected. It is highly important to visualize the contrast in the subject and to know how much is desired in the photograph, before selecting film, filter, if any, and developer. One type of panchromatic film is never satisfactory for all photography of colored objects. Recourse must be had to all. If the discrepancy in contrast is too great between two successive grades of panchromatic films, an intermediate contrast can be obtained by developing the higher-contrast film in a lower-contrast developer than would otherwise be used.

2. Incorrect Exposure

Over-exposure and under-exposure of the negative cause a serious loss of detail. In over-exposure the first loss occurs in the high-lights; an increase in the degree of over-exposure causes a further loss in the intermediate tones and, finally, in the shadows, when the film will show practically no detail at all. Nothing that is done will be as satisfactory as the correct exposure, but improvement can be obtained by the following treatments.

An over-exposed negative can often be improved, after development, by treating it with the appropriate reducer.[1] Bathing of the film in a 2% solution of iodine before development also decreases the density. Development of the negative for the usual time in standard developer that has been diluted six times with water, produces a negative of approximately half the density with, however, at the same time, a considerable decrease in contrast. Cold developer and developers loaded with bromide also decrease the density of over-exposed negatives, with some increase in contrast.

In under-exposure, the order of loss of detail is the reverse of that with over-exposure, and the greatest loss occurs in the shadows. If the exposure has been long enough to record all of the detail of the subject, but has been too short

[1] Lumiere and Seyewetz, Reducers, *Brit. J. Phot.*, 1900, 47:805.

to produce satisfactory density, an intensifier can be used on the negative to increase its density.[2]

Negatives that are known to have been under-exposed can be improved by hypersensitizing with mercury before development.[3] Another method is to develop the film in special developers, such as Champlin 15, which give a great increase in density. The precaution should be taken of using these special developers fresh and in conjunction with a hardening bath after development.

When it is known that the exposure is incorrect, but doubtful whether the fault is under- or over-exposure, the Joanovitch two-bath developer should be used.[4]

3. Incorrect Contrast

Excessive contrast in the negative causes a lack of detail in the finished print. Films are able to record a much wider range of tones than paper. The extent of visible tones in a film may range from 1 to 150, and in paper from 1 to 80, so that it is impossible to reproduce film detail falling without the range of tone reproducible on the paper. The best that can be done is to choose a narrow region within the wider range. If an intermediate region is selected, detail is sacrificed at the extremes of high-lights and shadows. If detail is recorded in the high-lights, it is lost in the shadows; if recorded in the shadows, it is lost in the high-lights. In all cases, a compromise has to be effected between the negative and the paper. It is much easier to bring about a satisfactory compromise if the contrast in the film is not too great. Dodging, holding back parts of the negative during enlarging or printing, also adjusts the tonal range of the film more closely to that of the paper. Some causes of excessive contrast are over-development, harsh lighting, and the use of film, paper or developer of too high contrastability.

A negative that is too flat will of course be more or less in monotone, with very poor tonal differentiation. Detail is usually best brought out in a slightly flat paper print because the tonal range is greater with less contrast, but when the lack of contrast is increased too much, differentiations of tones disappear and detail is lost. The contrast sought in the final print is determined by the type of photograph and the use to be made of it. A slightly flat print can be made to appear of greater brilliance without sacrifice of detail by printing it

[2] Baker, Theory and practice of intensification, *Brit. J. Phot.*, 1906, 53:264, 284, 309.

[3] Dersch and Dürr, New method for the dry hypersensitization of photographic emulsions, *J. Soc. Motion Picture Engineers,* (Feb.) 1937, vol. 28, no. 2.

[4] The Joanovitch two-bath developer, *Camera* (Lucerne), (Feb.) 1932, p. 267; *Brit. J. Phot. Almanac,* 1933, p. 213.

with black borders instead of the usual white ones.[5] The causes of flat pictures are in general the opposite of the causes of excessive contrast.

4. Fog

Fog is a density on the sensitized surface consisting of the same material as the image but not caused by the exposure; it may be either local or general.[6] Careless handling of photographic materials, faulty safelights, improper mixing of chemicals, contamination of developers and the use of stale sensitized films and papers are a few causes of fog.

General fog causes pictures poor in contrast, while detail in the shadows is clouded, or wiped out altogether, depending upon the quantity of fog. Fogged negatives are sometimes printed on paper of a higher grade of contrastability than would be normally used, but when this is done, loss of detail resulting from two faults—fog and excessive contrast—is increased.

It is best to remove fog from the negative by means of a subtractive type of reducer before printing. It is excellent practice to pass every negative through such a reducer for an instant to remove the slight fog inherent in most films and developers. This procedure increases the brilliance of the negatives, but care must be taken that the reduction is stopped just before detail is attacked.

Haber's[7] excellent but more difficult method is based upon the fact that most fog lies on the surface of the emulsion. The negative is bleached and then redeveloped, the re-development being stopped just before fog appears. It has the advantage over the above method of allowing repetition, and for removing considerable fog without loss of detail, but the former is more satisfactory for removing slight fog, and fog below the surface, and for general routine.

5. Grain of the Negative

Coarseness of grain in the negative may be caused by emulsion granularity, improper processing and over-exposure. In the final analysis, the minimum of "graininess" is determined chiefly by the emulsion. Films may be classified as coarse, medium and fine-grained; in general, the faster the film the coarser the grain. To secure fine grain, one must start with a suitable film.

The use of a fine-grain developer and a mild fixer, and accurate control of

[5] Reproductions of chest radiographs printed in this manner under the direction of Dr. F. Maurice McPhedran were exhibited at the 1938 Salon of The Biological Photographic Association.

[6] Busanovich, Photographic fog, *The Camera*, (Feb.) 1935.

[7] Haber, *Phot. Rund.*, (March) 1932, p. 118.

temperature are also essential. Such developers contain little or no alkali, for strong alkalis soften the gelatin, break down the cells of the emulsion, and increase the clumping of the grains of silver. The reduction of the contrast constituent in developers is favorable to fine grain; the addition of extra potassium bromide causes a further reduction in clumping with a resulting loss, however, of emulsion speed. It is not possible to determine conclusively which developer will produce the finest grain, because its quality depends to some extent on the emulsion with which it is combined. In most cases, the influence of the developer is most considerable with a coarse-grain emulsion and is practically negligible with a fine-grain film. In all cases paraphenylenediamine, with its disadvantage of increase in development time, has the advantage of contributing least to graininess.[8]

Unless the film is thoroughly rinsed before immersion in the fixer, the chemical action taking place between the strongly acid fixer and the alkaline developer produces a turbulence which results in a coagulation of the grains in that state. To minimize this effect a mild fixer is used. It is also highly important to maintain the water and all solutions continually at the same temperature. Any temperature variation during processing will cause distortion of the surface of the gelatin and change the positions of the grains in the emulsion. Very high temperatures may cause the gelatin to leave its support, and sudden great changes may cause visible reticulation. Changes in temperature while drying the films may have the same effect as changes in the temperature of solutions. The "graininess" of the negative can be determined by the microscope, by projection, or by inspection of a print on glossy paper.[9]

6. Halation

Halation is "the spreading of light beyond its proper boundary in the negative image on the plate, producing local fog around the high lights etc." It is caused by the reflection of a bright image through the emulsion, thrown back by the celluloid film base so as to give a virtual spreading of the bright image upon the sensitized surface. Loss of detail is, consequently, only local. Films are not affected so much as glass plates. Present-day films are, in fact, but slightly susceptible to halation, but it is still encountered when the reflection

[8] Van Kreveld and Scheffer, Graininess of photographic materials, *J. Opt. Soc. Am.*, (March) 1937, vol. 27, no. 3.

[9] For negatives smaller than 2¼ x 3¼ inches, fine-grain technique is most essential, and it may be necessary for larger-sized negatives if high-speed films are to be used for enlargements of four diameters or more.

or source of light is very strong. It can be prevented by coating the unsensitized surface of the films or plates with a special non-reflecting mixture, or by softening the light source and reflections to such a degree that they will not affect the film. An "halated" film or plate can often be improved by rubbing the affected area with a tuft of cotton soaked with alcohol, or by local application of reducers or abrasives.

7. Poor Definition or Unsharpness

Poor definition is caused by movement of the subject or the camera during exposure, improper focussing, lens aberrations, and poor contact of the film in camera or in printer. A slightly blurred negative can be improved by printing the film on a harder (higher contrast) paper than normally used, because of the relation between contrast and sharpness; that is, the contrast between two areas appears greater if the boundary line is sharp, and the separation of two areas appears sharper if the contrast is increased. The higher-contrast print causes a loss of detail, which is sometimes less objectionable than the lack of definition. The production of clear, sharp negatives, however, is the best procedure.

One of the most common causes of poor definition is a poor lens. Although modern lenses are made with increasing precision, none is free from all defects; and some aberrations have to be tolerated that are less objectionable than others. It is advisable to test them before using for spherical aberration, coma, curvature of field and all other lens defects. Miller[10] has evolved an excellent technique for testing lenses for all common faults. Usually camera objectives show the best resolution at about f:10 or smaller.[11]

The superiority of the contact print over the enlargement lies in the fact that enlarging cannot produce as sharp a print, owing to the additional aberrations in the lens used for projection. Much has been said about the ease and simplicity of handling of the miniature camera, but for sharper, finer detail there is nothing comparable to a large-sized print made by the contact method.

Additional Notes on the Print

Although some of the factors that cause loss of detail in the negative (incorrect exposure, fog, unsharpness, marks, and incorrect contrast) also apply

[10] Miller, W. C., Technic for testing photographic lenses, *J. Soc. Motion Picture Engineers,* (Nov.) 1938, vol. 31, no. 5.

[11] Nutting, P. G., Resolving power of objectives, *Bull. Bureau of Standards,* (Aug.) 1909, vol. 6, no. 1.

to paper prints, only incorrect contrast is considered here briefly, because methods for control of the other difficulties are generally the same for both.

As has been indicated, there are on the market various grades of photographic printing paper to reproduce various degrees of contrast. The best results are obtained when the contrast of the negative is such that it can be reproduced satisfactorily by contact printing on number 2 or number 3 paper. When, however, the negative has only two tones, intense black and pure white any grade of paper of higher contrastability than number 3 may be employed. Sometimes the negative does not give the desired effect on any grade, and special treatment of the paper is then required. For example, if a negative produces too high a contrast on the paper used, lower contrast can be obtained by the Sterry method, that is, bathing of the paper prior to development in a .5% solution of potassium dichromate from ½ to 2 minutes.

In the handling of bromide and chloro-bromide papers, changes in exposure and development to alter contrast is not recommended because of the change that will also occur in the color of the image. In projection printing, there is possible only a moderate amount of control of contrast. Enlargements made at smaller stops will have slightly more contrast than the ones made with large openings. The use of white light, rich in ultra-violet rays, as a source of illumination will lessen contrast in the negative, whereas yellowish or reddish light will increase the contrast. Greater control of contrast in projection may be obtained by the construction of a gradation transformer,[12] which utilizes the Callier effect to obtain various contrasts from one negative with one grade of paper.

[12] Neumann, H., Optical control of gradation, *Brit. J. Phot.*, (Dec. 31) 1937, vol. 84, no. 4052.

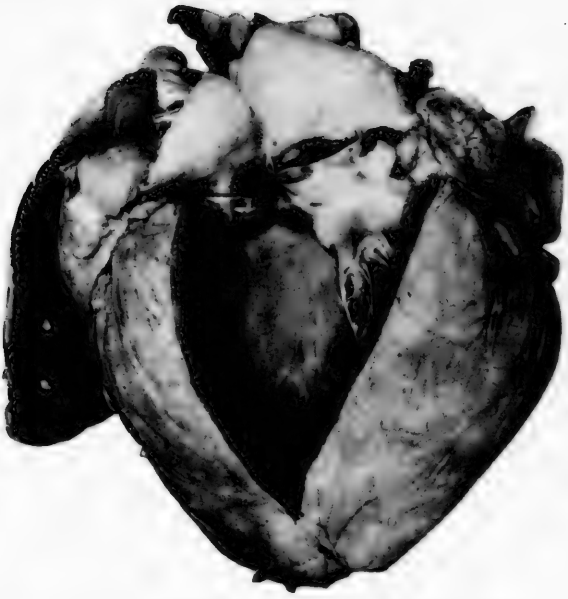
LEGENDS

Fig. 1. Medical specimen photographed on orthochromatic film. Compare detail in fig. 2. Also note that with this type of film and exposure best adapted to the specimen, and without dodging, the black and white ruler is not well shown.

Fig. 2. Medical specimen photographed on panchromatic film, with technique otherwise the same as in fig. 1, showing finer detail and differentiation of tones, especially in the red areas.

Fig. 3. Contact print, without dodging.

Fig. 4. Print made with the same technique as fig. 3 but with dodging to bring out detail in the lower lung-fields.



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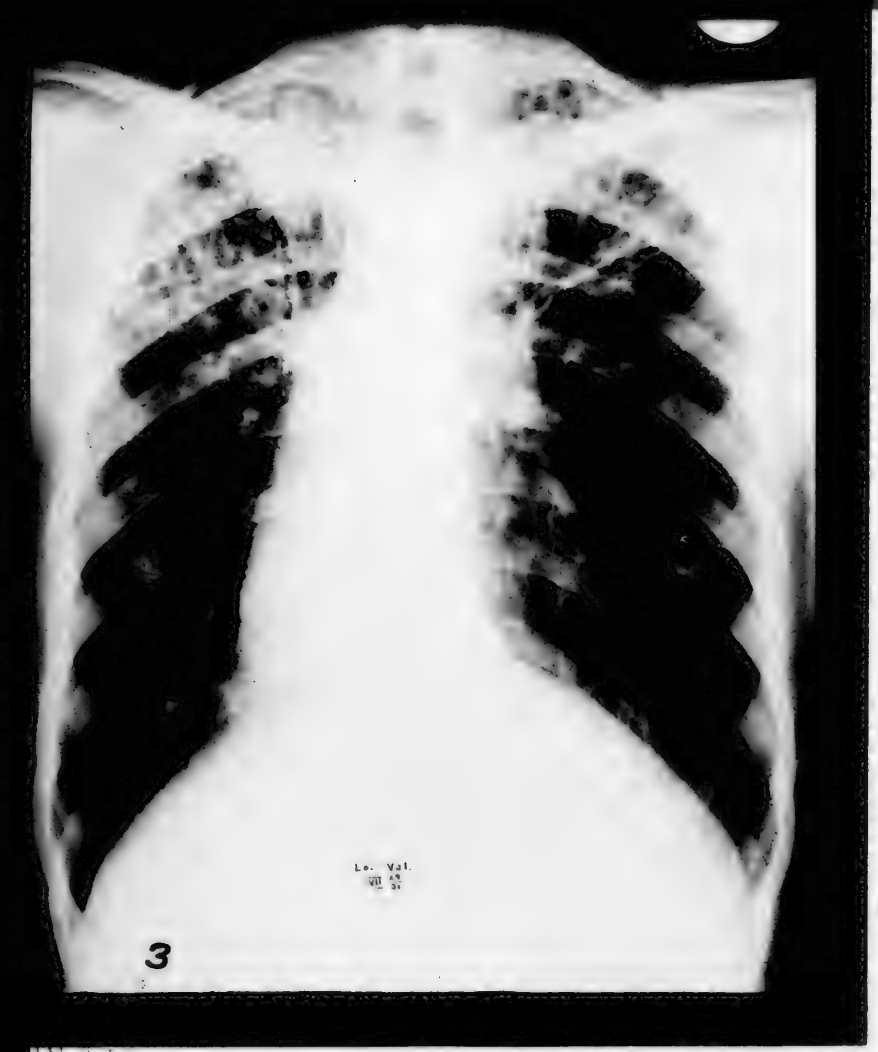

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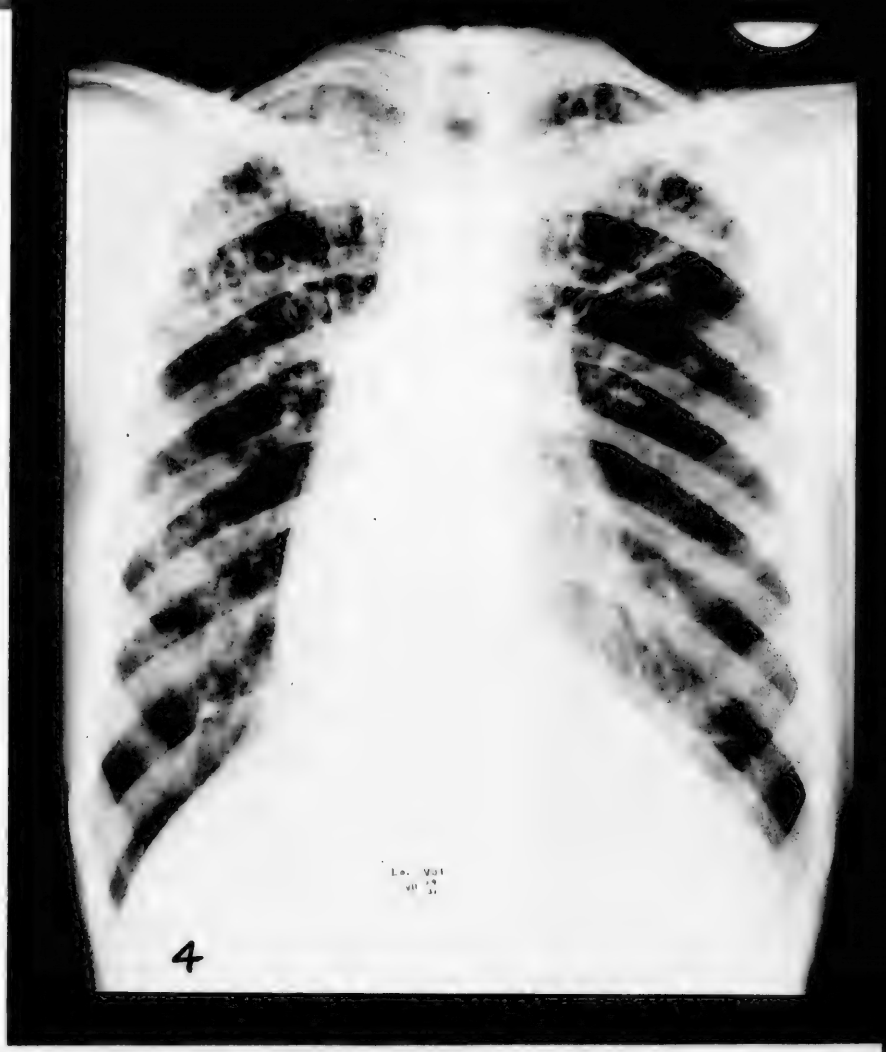

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PHOTOGRAPHING GROSS SPECIMENS ON KODACHROME FILM

ALBERT LEVIN*

THE technic of producing photographs on Kodachrome film does not differ greatly from that used in making black and white photographic records. There are, however, some points in which the method differs, and in order to correlate these points a complete description of the procedure is necessary. The following directions are for Kodachrome Type A film and artificial light.

The apparatus used is as follows: a 35 mm. film camera with an arrangement for a full-size ground-glass focusing screen; a 135 mm. focal length lens with a set of extension tubes; a lens shade; a Pola screen and a magnifying glass for focusing the image; a rigid tripod with a tilting top; two lighting units, consisting of a pair of clamp-on reflectors with stands using No. 2 Photoflood bulbs with spun glass diffusion screens; a photo-electric cell exposure meter; a white enamel tray large enough for the specimens to be photographed, and a celluloid ruler.

Daylight must be completely excluded from the room in which the photographic work is to be done. Since ordinary window shades are not usually sufficiently opaque to light rays an extra set of curtains made of an opaque material is hung over the windows. A clear floor space measuring about 6 x 6 ft. is necessary for the working area.

The specimen to be photographed is washed in a basin with tap water to remove superfluous blood and then dried with a towel, preferably of a fabric that will not leave lint. Linen hand towels are very satisfactory for this purpose. The object is placed on the white enamel tray and arranged to show as clearly as possible the pathology that is present. The ruler is fixed adjacent to the area containing the pathology and the tray containing the specimen is placed on the floor, with the camera head set in the vertical position.

The two lamps using No. 2 Photofloods, with the diffusion screens in place, are set up on opposite sides of the specimen. The specimen is flooded evenly

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From the Department of Photography, Montefiore Hospital, Isaac Kaufman Fund, Pittsburgh, Pa.

with light directed from a height which will illuminate the deepest indentation on the surface. It is advisable to keep the lamps as low as possible. The shadows must be well illuminated in order to keep the color rendition correct, for on Kodachrome film, a shadow that is too dark does not record as a darker tone but as an incorrect color. The distance from the lamp to the specimen is equal to approximately twice the greatest diameter of the specimen. For example, a portion of intestine that has been cut open and measures about twelve inches in length is to be photographed. In this case the lamps are placed about 24 inches from either end of the specimen and at an angle of about 15 degrees from the floor. On the other hand, when photographing an organ like the brain, the lamps are set about 18 inches from the specimen and at an angle of about 45 degrees from the floor. It is necessary that the illumination in all cases be even and soft since this process does not allow the usual compensation that one can make when printing a positive from a negative.

The use of a Pola screen is very strongly recommended. A single screen over the lens will improve the color very definitely and will also reduce the intensity of high lights on wet surfaces. The correct angle for the screen is obtained by viewing the image on the ground glass while rotating the screen. The exposure is doubled when a Pola screen is used.

The very small film area available makes it imperative that all the space be used and the camera operated at such a distance as to fill the picture area completely. One advantage of the 2″ x 2″ slide is that it allows the use of the full picture area for either vertical or horizontal composition. This circumstance is employed to the fullest degree in order to obtain as large an original as is possible. Subsequent projection-screen-size is then kept at a minimum.

After the lamps have been adjusted so that the illumination appears balanced to the eye, the exposure meter is used to check this factor, and the correct exposure time is determined. Kodachrome film Type A is rated at 12 degrees on the Weston scale, but since there is a great variation in the individual sensitivity of photo-electric cell meters, a series of tests are made to determine the correct film speed for the specific instrument in use. The reading is taken with the meter about 6 inches from the surface of the specimen, care being taken that the meter does not cast a shadow in the photographic field. The image is focused carefully with the aid of the magnifying glass, making certain that the ruler as well as the specimen is in good focus. After the set-up is re-checked for arrangement, the exposure is made.

It is advisable to make two or more exposures thus eliminating the difficulty

Figure 1. Complete set-up for photographing gross specimens on Kodachrome film.

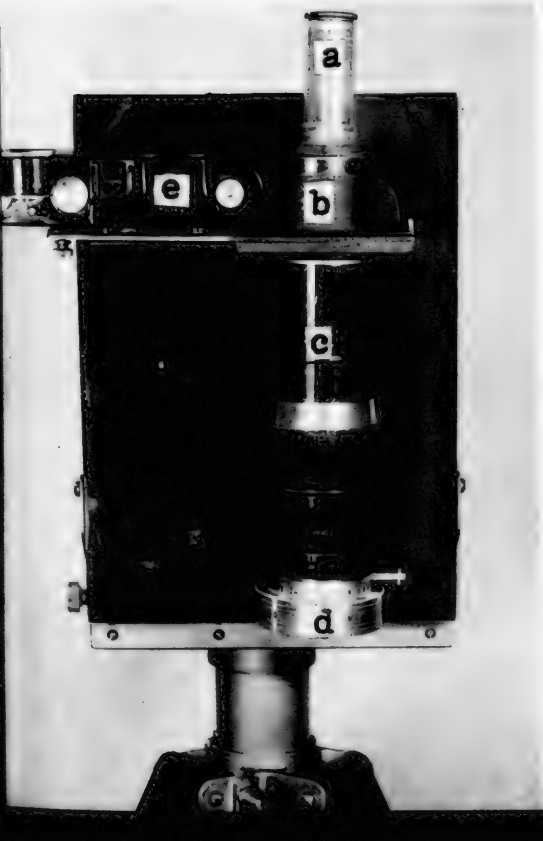

Figure 2. Camera unit. a. magnifying glass, b. ground glass focusing screen, c. 135 mm. lens, d. Pola screen and hood. e. 35 mm. film camera.

UNIV. OF MICH.

of making duplicates from the film positives later. A careful record is kept of the exposures made in order to facilitate identification of the picture when the roll is returned from the processing laboratory. The film roll is intended for eighteen photographs. Ordinarily, however, between twenty and twenty-two pictures can be taken on a roll.

The exposed roll of Kodachrome film is sent to the manufacturer by special delivery mail containing return postage and a note enclosed requesting its return in the same manner. With this arrangement films are usually returned in four or five days. When the film is returned, it is hung up with a small weight on one end to take out the curl. The uncurled film is much easier to handle in the slide binding procedure.

In completing the lantern slide plate, the piece of film with a mask is placed between a pair of 2″ x 2″ cover glasses. A slide binding tape ⅜ of an inch wide is used for binding. A strip of gummed paper which serves as a thumb mark and provides space for an identifying number is placed in the correct position on the outside of the plate. The original record made when the film was exposed is kept at hand, and the plates numbered as soon as they are completed. The film strip should never be projected without being bound, since there is great danger of scratching the surface.

The projection machine as well as the screen must be of good design for satisfactory results. The projector should be equipped with a light source sufficiently strong for the usual projection distance with the lens of such a focal length as to allow the operation of the machine from the rear of the room. A glass-bead screen will give best results, but in its absence either a flat white painted surface or a white cloth will be satisfactory. A pure white color in the screen is absolutely essential.

The foregoing procedure gives uniformly satisfactory photographic records in natural color, of all surgical and autopsy material entering this pathological laboratory.

USE AND APPLICATION OF PHOTOGRAPHY IN MYCOLOGY

TIBOR BENEDEK, M.D.*

PHOTOGRAPHY has in every discipline its particular problems. To deal with them, special devices are often necessary to attain an objective.

In mycology the chief problem is to preserve the gross cultural characteristics which are fairly constant and of great importance in identification and re-identification of species by subsequent observers. The giant culture is the carrier of the gross cultural characteristics. As a general rule experienced mycologists use Erlenmeyer flasks instead of Petri dishes in making giant cultures.

Photographs of giant cultures through the glass wall yield a distorted picture depicting the circle as an ellipse because of the necessary tilting. To avoid this there are two possibilities.

The first is an ingenious construction by Claus, recommended by Karrenberg,[1] noted mycologist, consisting of a kind of Erlenmeyer flask in two parts. The lower part, similar to a Petri dish, to hold the medium, and an upper part, similar to the conic side wall of an Erlenmeyer flask, fitting over the bottom on a ground edge. The two parts are held together by a metal plate underneath and a ring around the neck of the flask connected by three springs which work into the upper ring to provide sufficient compression to prevent contamination.

The principal idea of this device is to enable, theoretically at least, the removal of the upper part of this structure as often as it is necessary, leaving the giant culture to immediate observation or to photography. In this way the lower container can be placed vertically to the optical axis of the camera, avoiding distortion.

Theoretically this device is ingenious and ideal but not practical. Its first aim is to allow successive photographs of the progressive development of the giant culture. This aim cannot be reached as I learned by experience, because the surface of the culture becomes contaminated despite the greatest precau-

* Received for publication December 28, 1938. Laboratory for Mycological Research, Department of Dermatology, Service: Dr. A. W. Stillians, Northwestern University Medical School, Chicago, Ill.

[1] Karrenberg, C. L., *Dermat. Wschr.*, 85:1706–1708, 1927.

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tionary measures; even a few days after one exposure the giant culture is lost. In practice the assumption of a possibility of a regular and continuous culture "kinematography" was thus a failure. Besides these objections the price of the flask was directly prohibitive.

Mine is a simpler method. I made up my giant cultures for hyphomycetes in Erlenmeyer flasks of about 200 cc. contents, price 17 cents. If I wanted to fix only the final gross cultural characteristics of a giant culture I used one flask. After the culture stopped growing, 2 to 3 months, I cut off the conical portion of the flask without disturbing the culture medium or the fungus growth. The giant culture remains supported tightly by the glass bottom, the curved edge of which is retained.

In order to make a photograph of this giant culture in any desired position I make a "nest" or mould for it from plaster of Paris, figure 1. A cigar box is used, its size depending upon whether the nest is made for only one giant culture, or, for purposes of comparison, it is preferable to photograph two or three giant cultures at the same time, e.g. to show comparatively the gross morphological features of a given species of the same genus on a common nutrient medium. In preparing a nest, fill a cigar box of the necessary size, i.e., 8¾ by 5 by 2¾ inches, with plaster of Paris mixed with water up to the rim. Wait until just before the mixture becomes semi-hard, then press into the center of this even surface, the bottom portion of an Erlenmeyer flask of the same size used for the giant culture about 8 mm. deep. Before making the impression, the whole bottom as far as it digs in must be coated with glycerol in order to prevent the glass from sticking to the plaster. After an hour or so when the plaster of Paris is hard, the empty bottle can be easily removed and the nest is ready for receiving a giant culture with the glass bottom. Put a few drops of glycerol in the nest to get the proper adhesion for the glass bottom supporting the giant culture. By this arrangement the giant culture can be placed vertically to the axis of the photographic lens. Using a set of lenses with long focus—I use a view camera 5 inches by 7 inches with the Protar set of Zeiss—one can easily take photographs in natural size with the finest details, figures 2 and 3.

Another question is whether and how we can keep these giant cultures for a longer period of time without contamination in order to repeat the photograph or for some other reason.

After the photographs are taken the giant culture, supported by the glass bottom of the flask is placed in a sterile Petri dish, covered with its lid, and kept in the ice-box. This preserves the culture up to three months without

growth of contaminants despite the repeated uncovering of the lid during photography or study of the culture. But after repeated exposures 24 hours at room temperature are enough to ruin the culture by an almost explosive growth of the contaminants.

If it is necessary to follow in pictures the development of a certain species, I carefully prepare four to six similar giant cultures in Erlenmeyer flasks with equal parts of media, inoculated simultaneously. Then, after 4, 6, 12 weeks

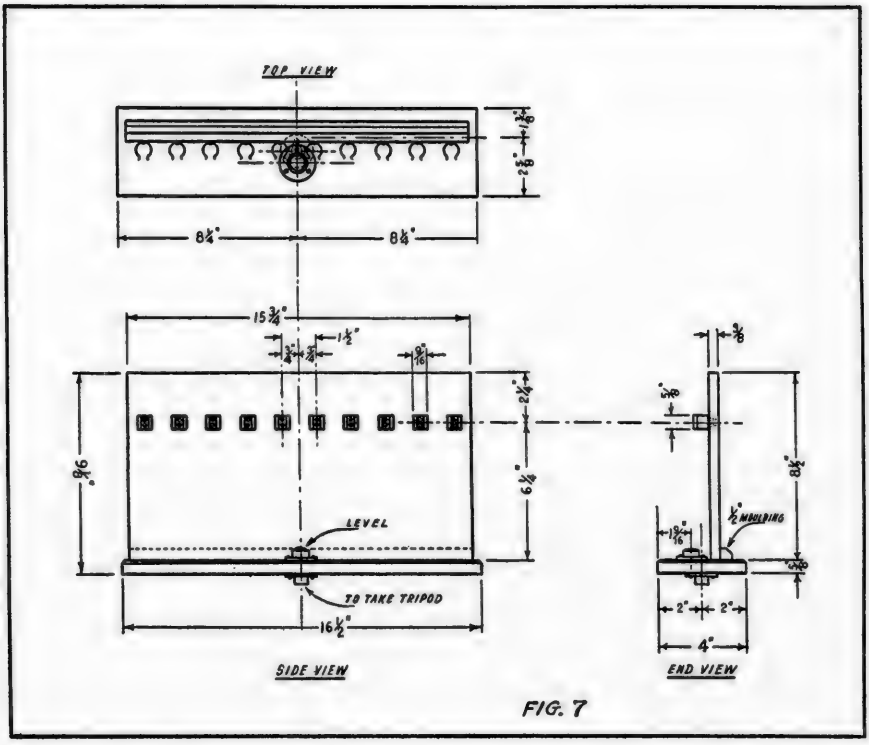
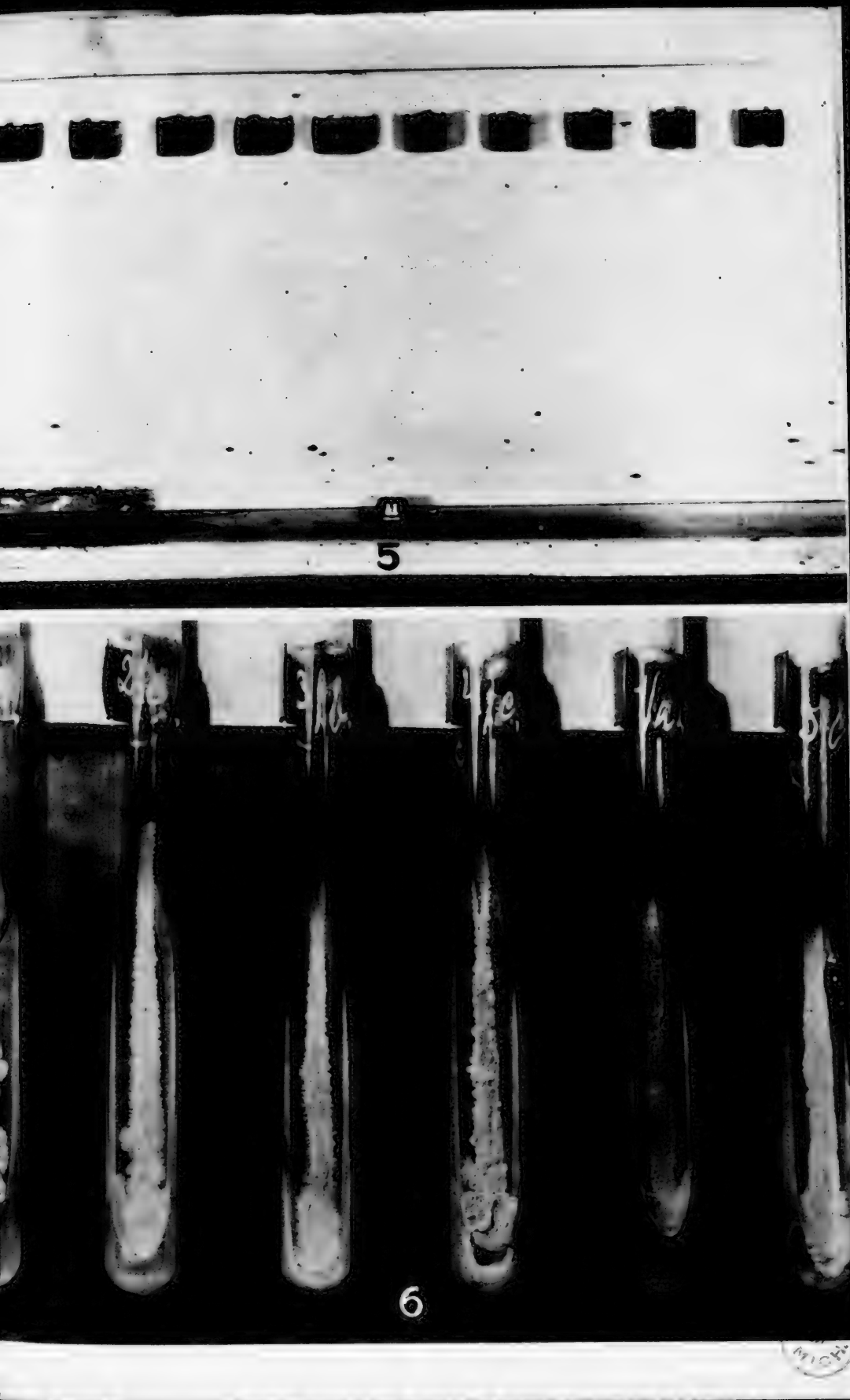


FIG. 7

or so the flasks are successively sacrificed and photographs made. Because all the technical data are identical, one has, in this way too, a "kinematography" of the cultural development.

Such a box of plaster of Paris has, however, another advantageous application. Since the surface of the giant culture and the surface of the box has practically the same level, one can use a miniature camera, e.g. the Leica for Kodachrome color photography of giant cultures.

The Leica camera must be used in connection with the setting device "Beooy" of Leitz, Elmar 50 mm. f:3.5, and with the supplementary front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lenses number 2 or 3, clamping ring and four adjustable legs. As known, the nearest distance of the critically sharp plane is one meter using the Elmar alone. To reduce the focus from one meter to 53.7 cm. or 39.2 cm. respectively, use the front lens number 3. These front lenses can be used also in connection with Hektor or Summar 50 mm. focus.

Kodachrome film, type A, can be used in sunshine or in bright diffused daylight or with photoflood light. Kodachrome gives excellent results. The values of the colors are quite natural. Kodachrome opens new possibilities for registration of gross cultural characteristics all the more because the color plays an outstanding role in differentiating fungus species. Color photographs thus are of great value for our files, for teaching purposes, for demonstrations.

I want to present one more device which was very useful to me for years in my photographic work. It is a holder constructed for the purpose of taking photographs of test tube cultures. A special description is not necessary because it is depicted in figure 5 with a detailed sketch, figure 7, which will enable anybody to have it made by a skillful craftsman. I want only to remark that the clips used are elastic in order to take test tubes with 16 to 25 mm. in diameter. When larger tubes are preferred, interchangeable clips are used to hold heavier test tubes up to 30 to 35 mm. in diameter, similar to the culture tubes of Claus, also recommended by Karrenberg.[2] The device permits comparative pictures of growth in similar or in different species. It can be used not only for mycological but also for bacteriological purposes, figure 6. The holder has a spirit level on the upper surface of the supporting board and a nut underneath to take a tripod. The advantage of these little gadgets is quite obvious.

Here is a trick to raise the contrast of the test tube cultures to be photographed. Place a black sheet of paper, figure 6, behind the test tubes if the growth is white or bright as in bacterial or yeast cultures. If the growth is dark, use a sheet of white paper or nothing for the holder is enamelled white. For the illumination, daylight or photoflood light can be used. If the latter is used, the test tubes will become damp after a little while. In order to remove this condensed vapor from the inside of the tube, it is only necessary to warm the tubes a little with the flame of a spirit lamp just before taking the picture.

Figure 6 is a photograph of a set of test tube cultures in a non-adjusted print. That is, all the unnecessary and disturbing details are still visible which can be easily cut out by using small strips of black paper on the glass side of the plate or film such as is used in mounting lantern slides.

In taking pictures of test tube cultures there is only one difficulty and that

[2] Karrenberg, C. L., *Derm. Zschr.*, 49:248, 1927.

is to keep out the glare. After some trial and experience, it is found that best results are obtained by using two floodlights and lighting under 45° from above downwards. The proper position of the floodlights must be tried and checked each time before the photograph is taken.

Summary. The present paper describes two useful devices for the photography of mycological or bacteriological specimens. The one is a plaster of Paris mould to take up giant cultures, the second is a holder for test tube cultures. The latter is provided with a spirit level on the top and with a nut below to permit using a tripod. A description is given of the use of the plaster of Paris mould in taking Kodachrome pictures with the Leica camera in connection with the accessory setting device "Beooy" of Leitz.

The sketch is the work of the artist, Gerold Gregg, Racine, Wisconsin. For his kind cooperation I would like to extend my thanks to Mr. Gregg.

TARGET FOR TESTING PHOTOGRAPHIC LENSES AND THE FOCUS OF PROJECTION PRINTERS[1]

LLOYD G. HENBEST*

A VERY common method of preparing a test object or target for checking the focus of enlargers is to expose and develop a photographic plate or film in such a way as to obtain maximum density all over the plate and, when dried, to scratch lines through the emulsion; thus producing clearly transparent lines in opaque areas. More recently very hard, contrasty images of a geometric design on film have been placed on the market. This film is satisfactory only when precision is not required. When precision focusing is done with a magnifier, a gradation from the transparent to the opaque areas in the emulsion is plainly visible which not only prevents exact focusing, but makes it difficult to decide whether the enlarger is yielding a satisfactory image or not. What is necessary, is a microscopically thin, sharp margin that lacks gradation between the transparent and opaque areas. This is not obtainable with a photographic emulsion.

Another type of focusing accessory that has been recommended in the past, is prepared as follows. A glass plate is covered with lamp black by means of a

[1] Published by permission of the Director of the Geological Survey, United States Department of the Interior.

* Received for publication May 21, 1938. Geological Survey, United States Department of the Interior, Washington, D. C.

candle or kerosene flame; through this opaque film on the glass plate, fine parallel lines are drawn with a soft needle or pin. This prepared plate, moistened with crude turpentine and dried and covered by a series of coverslips of graded thickness, has been recommended wherever it is necessary to improvise an instrument for testing the spherical and chromatic corrections of microscope objectives.

Much better test objects are available in the form of fine, parallel strips of very thin silver film deposited on the under side of a long, slender, wedge-shaped cover glass, the upper and lower surfaces of which are optically plane, though not parallel. This wedge is about 0.10 mm. thick at one end and about 0.23 mm. at the other. The wedge is mounted, silver side down, on a standard 25 x 75 mm. microscope slide. The slide bears gradations indicating the thickness of the wedge; thus giving a measure of correction for cover glass thickness. This instrument is known as the Abbé test plate and though generally obtained directly from Carl Zeiss or Beck it might be procured from or through the agency of other manufacturers of microscopes. With the Abbé test plate and a good microscope stand, an experienced microscopist can determine the degree of spherical, chromatic, and certain other corrections possessed by a good microscope objective. Conrad Beck[2] greatly prefers a silver film which contains a few minute pin holes rather than the series of parallel lines.

The Abbé test plate is a specialized instrument and has little or no usefulness outside of microscopy. Its construction, however, is of particular interest here because it suggests a parallel and perhaps more critical type of test plate for checking the focus of enlargers and for testing the geometric optics of color filters and lenses.

Some time ago it occurred to the author that an ordinary silvered glass mirror could be converted into a large test plate for photographic lenses that is analogous to the Abbé plate. Such a test plate is very simple to prepare and costs little. It is durable and will withstand considerable heat. Although unaware of previous use of a glass mirror for this purpose, it seems highly probable that other individuals or perhaps manufacturers of some of the recent enlargers which contain a built-in test object in the negative carrier, may have employed the same device.

Methods of Preparation

According to the precision desired, various methods may be followed in preparing a test object from a glass mirror. Two procedures for making test

[2] Beck, Conrad, The Microscope, Theory and Practice, p. 230–238, 1938, London.

plates will be presented to satisfy all needs of amateurs. No attempt will be made to describe the silvering and etching methods of preparing large or very precise targets.

An inexpensive and satisfactory focusing object may be prepared as follows. A small glass mirror which may be obtained from a ten cent store, is cut to the size desired, and with a sewing needle, lines are scratched through the silver and the protective coating of paint. The frilled edges of silver film and debris from the paint backing may be removed by scrubbing the back with soap lather and a soft brush or cloth, followed by a thorough rinse with tepid or cool water. This completes the preparation of the test plate for use in enlargers of large negatives.

If this object is to be used in enlargers that have lenses of 50 to 120 mm. or less equivalent focus, the paint backing should be removed so that the silver film will lie exactly in the same plane as that of the negative emulsion. The backing should be removed before the lines are scratched. This is accomplished by using xylene and alcohol, but it is likely that a paint remover would be better. The silver film is generally delicate, and for that reason the paint should be scrubbed or wiped away only with a very soft cloth or wad of cotton. The backing often contains a gritty filler which is capable of scratching holes in the film; however, a few pin holes of various sizes scattered through the opaque areas would actually increase the usefulness of the test plate.

Glass mirrors of this grade frequently contain such imperfections as curvature, "heat waves," and "cat eyes," as they are variously called, but are entirely adequate for use with the average enlarger if some care is exercised when selecting a sample.

For some purposes it may be worth while to obtain a better grade of glass and to prepare the test object with more care than was required in the method described above. Plate glass mirrors are obtainable which are relatively free of imperfections, the surfaces of which are so well polished and plane parallel, that their defects are of no consequence.

Also more care in preparing the lines of denuded glass will be worth while. A phonograph needle ground on a razor hone to a sharp, thin, straight-edged chisel point, will serve admirably. If the chisel is held at an angle of about 45° and pushed forward along a straight-edge, a clean strip can be removed. By this means much less pressure is required, and danger of scratching the glass is greatly decreased. If further care be needed, or a special design required, it seems probable that the silver could be removed by coating the silver film with paraffin and then etching in a nitric acid bath the silver uncovered by laying out the grid of lines with a soft steel or brass needle. The paraffin could be

removed with a solvent such as xylene when etching is completed. This would certainly avoid scratching the glass. Scratches or lines of strain should be avoided in a plate for accurate tests, as they could cause confusion by introducing color and diffraction bands at or near the margins of the silver film.

The most appropriate width and arrangement of the lines will depend upon the particular requirements. A simple grid of two sets of parallel lines spaced 5 to 10 mm. apart at right angles will serve the needs encountered by those who use lenses of 2- to 10-inch focal length. Ordinarily, lines 0.1 to 0.3 mm. wide will serve most purposes. Alternating wide and narrow lines would extend the range of usefulness for lenses of greater focal length.

There are several reasons for using the test object with the silvered side of the plate toward the lens. When the test object is used for focusing enlargers, the silver film by this means occupies the position of the negative emulsion. If the enlarger objective has an equivalent focus greater than 16 to 18 cm., the paint backing should be left on the mirror both as a protection to the delicate silver film and as a light absorbing medium, thereby avoiding a back lighting of the opaque areas by stray light between the test object and the lens. Whether used for testing a lens or for a focusing instrument, the glass in this position cannot disturb the corrections of the lens, a result that would follow wherever an appreciable thickness of any medium having a different refractive index from that of air (for which photographic lenses are ordinarily corrected) was interposed between the lens and object.[3] Furthermore, uneven surfaces, imperfection, and stress within the glass are thereby removed from chance of degrading the image. Such imperfections in that position can only cause more or less imperceptible irregularities in lighting and would be of no consequence whatever in ordinary use.

This type of focusing object is unfortunately not suitable for use in enlargers built to receive only film strips. For this purpose, film strip test objects are available while some of the newer enlargers have built-in test objects.

One of the advantages of this type of test plate is the extreme range of size that is available. The silver film itself is so thin that if mounted, or covered and illuminated properly it would serve even as a test object for a microscope objective. Its superiority over the test plates for color filters that are made by sticking strips of black paper to a glass plate, is evident.

An additional and important advantage is strikingly evident in the brilliant, and extreme contrast available, which makes it possible to obtain a clearly

[3] This effect is negligible even with lenses of large numerical aperture if the thickness of the material having a considerably different refractive index is less than one-thousandth the object-to-lens distance.

visible image even with the small amount of light passed at the smallest stop of the enlarger lens. Thus it is possible to check the performance of landscape camera lenses when used for enlarging. Such lenses are generally corrected for an object-lens distance of at least 100 focal lengths, and although they may yield an excellent image in landscape work, on enlargers they will generally not yield equally fine definition at full aperture. By means of this test object and a well corrected magnifier for studying the image, it is easy to discover by trial, the largest aperture at which optimum definition is obtained. Thereafter one can focus at that aperture unless the slight blurring of the full aperture is desired for pictorial purposes.

I have recently found a further use for this type of test object. Needing to check the most appropriate apertures for using the supplementary lenses for my landscape camera objectives, I employed the following method: A 5 x 7 inch test object was framed in cardboard and tied on the front of a 10 inch Victor reflector in which a 40 watt bulb had been screwed. The cardboard frame served as a mask to stop all but the light passing through the target. The reflector supplied an illuminator of entirely sufficient numerical aperture to avoid the introduction of diffraction because of improper illumination. This target and the camera were set as far apart as the premises allowed (about 75 focal lengths; a distance of 200 focal lengths or more would have been better for my purposes). The camera was clamped rigidly to a table, focusing screen removed, and a well-corrected, anastigmatic, 27-power hand lens on a support was used to examine the image in air. Owing to the difficulty of mounting and properly orienting the hand lens, except in parallelism with and near the principal axis of the camera objective, only the definition in the center of the field was tested.

The target offered such hard, sharply defined boundaries that the focus and definition at all apertures were surprisingly easy to determine even where a Distar 2.5 diopter was attached. The tests were made at night with all lights except the target illuminator turned off, thereby avoiding lens glare produced by stray light.

Test Plate for Studying Performance of Microanastigmats

Practical information on the use of photomicrographic objectives such as the *Microtessar, Microsummar, Microplanar* series may be gained by studying their performance with an appropriate test plate. Such a plate may be made easily by selecting a good quality of thin glass mirror (1 to 1.5 mm. thick); cutting to size desired (75 x 35 or 75 x 50 mm.); removing the paint back-

ing; and drawing a grid of fine lines with a needle-point through the silver film. The lines should be spaced about 3 mm. apart, and each series drawn parallel. A few pin holes here and there are an advantage. Care should be exercised to avoid scratching the glass. This completes the preparation of the plate as the silver film need not be covered, though a cover glass of standard (0.17 mm.) or substandard thickness would probably make little or no appreciable difference in objectives of such low numerical aperture (at f: 4.5 and a magnification of 10 diameters the numerical aperture is 0.10).

The test object should be illuminated from below by a solid cone of light the numerical aperture of which is equal to or is at least three-fourths that of the objective in use. A convenient method of determining whether this condition is fulfilled is to focus the objective, remove the ground glass, and, while looking through the objective, open and close the substage diaphragm. By watching the image of the diaphragm it is easy to see when the objective aperture is filled with light.

In studying the performance of these objectives it is necessary to magnify the image which they produce. The ground glass should be removed and the image studied in the air. A well-corrected hand lens of 10 to 15 power is needed. If the apparatus permits, images of at least two magnifications should be studied, a low (about 10x) and a high one (about 60x). If these images are magnified by a 10 power hand lens, the resulting, final magnifications will be 100 and 600 respectively, or approximately 1,000 to 6,000 times the numerical aperture of the objective. Inasmuch as the highest, useful magnification is normally 750 to 1,000 times the numerical aperture of the objective, at the magnification suggested, it is possible to observe the quality of the image, the effects on resolution, and the focal shift that are caused by opening and closing the diaphragm.

To determine whether serious focal shift exists, the lens is stopped to f: 11 and focused precisely, then without altering any other adjustment the diaphragm is opened to f: 4.5. It can then be ascertained whether the objective remains in focus. A slight focal shift must be tolerated wherever the lens is being employed at any but the exact magnification for which it was corrected.

The degree of correction for color is very important in practical use for those who occasionally are forced to use color filters whose transmission characteristics make it necessary to focus with white or green light and insert the proper filter for exposing the film. The test object provides such a sharply defined image that it is easy for the photomicrographer to determine whether the focal positions vary to a serious extent with the filters which are employed. Obviously, it is necessary in such an examination to use the filters *between the*

source of light and the object or the substage condenser. The introduction or removal of a filter anywhere between the object and the image without optical compensation would cause a focal shift.

Two other important, practical considerations in the use of the microanastigmats are depth of focus and resolution. These characteristics are not available at once; hence, for the work at hand it is necessary to decide which is preferable, great depth of focus and poor resolution or shallow focus and good resolution. In photographing the external features of objects having relief, the photomicrographer is confronted with the necessity of making a compromise between resolution and depth of focus. By experimenting with the test plate the relation between resolution and aperture can be learned, and should be noted for future use. Unfortunately, the test plate is not adaptable for studying depth of focus.

These suggestions are not offered as directions for testing microanastigmats, but rather as a method of gaining important, practical information on the use and limitations of the instrument. An experienced or skillful microscopist, however, could attain both ends at once.

General Precaution

Although it has been suggested above that a test plate made from a mirror would serve as a most rigorous object for judging the performance of lenses and filters, the tyro should be cautioned not to form a judgment on the performance of a lens unless a number of important conditions such as the object-lens-image distance ratio for which the lens is corrected, proper orientation of the optical units, the appropriate numerical aperture of object illumination, reasonable limits of resolution, etc., are properly considered. A test plate of this kind if used on a lens corrected for landscape work would either have to be placed at or near infinity or these conditions duplicated by means of a highly corrected collimator system. Accordingly, an excellent lens for landscape photography would very likely yield a relatively poor image if the test plate were used at a distance of only a few focal lengths. Likewise an objective corrected for enlarger or laboratory camera use could not be expected to yield an equally fine image of an object at infinity. Important among other sources of error of technic in appraising the corrections of the lens is the performance and manner of using the hand lens employed to magnify the image. Even the improper orientation of a good aplanatic magnifier may introduce appearance of poor chromatic corrections in the image. The above warning applies with equal force to the study of the performance of microanastigmats.

MOTION PICTURES WITH A BINOCULAR MICROSCOPE

ALBERT S. WELCH, M.D.*

THE ordinary binocular microscope can be used advantageously to take motion pictures with any amateur motion picture camera. No additional equipment other than that found in an ordinary laboratory is necessary. The camera may be mounted with clamps on a ring stand.

By careful attention to detail in setting up the apparatus, exceptionally good pictures may be obtained. Objects appear almost exactly as they do when looking through the microscope. With color film, beautifully stained leukocytes display not only their delicate cytoplasmic granules but also the disposition of the granules at different depths and the configuration of a meandering nucleus. The lovely azure tint of monolocular cells records faithfully. The fine rings of malignant tertian malarial parasites in stained red blood cells show with striking effect. Such subjects as fresh wet preparations of the blood in sickle-celled anemia are fascinating. In amebic cysts, the numerous nuclei can be demonstrated at different depths, even more clearly when thrown on the silver screen than when observed through the microscope. Furthermore, the action can be repeated over and over for purposes of careful and complete study. In unstained preparations of protozoa, such as Trichomonas, even the delicate cilia are caught by the recording eye of the camera.

The microscope must be scrupulously clean. A substage lamp such as that used for dark field illumination will furnish sufficient light for ordinary supersensitive reversible panchromatic black-and-white film or reversible color film. The camera may be stopped at f:3.5 or, with the new doubly sensitive film recently introduced, an even greater range of iris aperture is possible.

In order to determine the proper distance between the eyepiece of the microscope and the camera, a cardboard cuff can be made, its depth corresponding to the exact depth of lens to film as measured with dividers. This cuff is placed over the eyepiece of the microscope and a piece of ground glass laid on top of it when the microscope is focused so that the image on the ground glass is clear. Thus it should also be in focus when the camera is placed with its

* Received for publication December 27, 1938. 919 Rialto Bldg., Kansas City, Mo.

lens the same distance away. The microscope is focused in the usual manner, and the cuff carrying the ground glass is moved to or from the eyepiece until the image is clear; then the lens of the camera is placed exactly at this point. In some cameras, at universal focus, the exact position will be with its sunshade almost touching the eyepiece of the microscope.

The procedure then, step by step, in setting up for motion pictures with an oil immersion lens is as follows. The camera, not loaded, set at universal focus, is mounted firmly on a stand so that it looks directly into one of the eyepieces of a binocular microscope. The microscope may be bent at an angle of some 15 to 20 degrees, the more readily to accommodate the mounted camera and for ease and convenience of operation. Its eyepieces should be widely separated and the oil immersion lens placed in approximately the same position it will be in when a slide is inserted. The sunshade of the camera is a paper's thickness distant from the eyepiece of the microscope. The instruments are lined up with great precision and markings are made so that the camera and microscope may be separated and re-aligned quickly. Since vibration of the camera mechanism when in motion is easily transmitted to the microscope and its slide, causing suspended particles in the preparation to dance, the whole should be set up on a solid foundation; wooden laboratory tables are not satisfactory.

The next step is the arrangement of the light, and this is centered exactly, using the plane surface of the substage microscope mirror. The lamp is as close to the microscope as it can be placed, in order to obtain a maximum of illumination. The diaphragm in the microscope is set at 1, which is a little bit wider open than midway, and the substage may be raised or lowered as desired to give the best even field illumination. The 6 X, 10 X, or even 16 X eyepiece may be used.

At this point it is well to put a test preparation under the microscope, adjust the focus and set everything up as if a picture were to be taken. The object on the slide may be brought into focus with the eyepieces in their natural position; but having once been focused the eyepieces again are separated and the camera brought into position over one of them. The separation of the eyepieces allows room for the observer to look through one eyepiece without disturbing the position of the camera which is in position over the other one. The camera is then run as if taking pictures, and the effects of vibration noted on the object seen through the other eyepiece. If the object remains steady, and the microscope can be focused slightly to bring all the necessary details into view with-

out disturbing the position of the camera, then everything is in readiness for making the picture.

The camera is loaded and wound tightly, the slide with material to be photographed is placed in position and brought in focus. All instruments are carefully aligned, the stop is checked at f:3.5, the microscope diaphragm checked at 1, the blue glass, if any, removed from the lamp, and the picture is taken.

It is always well to wind the camera thoroughly between each shot, because scenes of biological material are likely to run much longer than ordinary scenes. The illumination necessary to register on the sensitive film is so intense that the observing eye is almost blinded; and the object may be barely visible while it registers nicely on the film. During preliminary preparations, blue glasses may be used over lamp and eyepiece to cut down the intensity of the glare, and the microscope diaphragm may be cut down until the picture is ready to be taken.

PHOTOGRAPHIC RECORDS OF PETRI DISHES

EUGENE MAIER, PH.D.*

MANY occasions arise in the bacteriological laboratory where it is desirable to obtain permanent records of Petri dish cultures. In the following, a method is described by which direct prints of such cultures can be made and whereby camera equipment is not needed. The saving of time and money by this method is considerable as compared with the expense involved in the regular photographic process. The method can be applied to advantage in the bacteriological examination of water and milk. After the cultures have grown in the dishes, immediate counting of the colonies can be postponed as the colonies can be counted from the prints made by this method at any time convenient. In the testing of disinfectants, or preparations containing disinfectants, like skin or dental cremes, according to the methods outlined by the Food and Drug Administration, prints as shown, figure 1, can be easily obtained which may serve as evidence and permanent records for later references.

If the material to be tested is plated out in Petri dishes with plane parallel

* Received for publication January 11, 1939. Florida Medical Center, Venice, Florida.

bottoms cemented to the walls of the dish (Hellige[1]), pictures of particular brilliance can be produced, because the thickness of the agar in a dish of this kind is uniform all over the plate.

For the purpose of demonstrating the value of this method, we have found the agar cup technique of Himebaugh[2] most suitable. A Petri dish is prepared with clear nutrient agar in the ordinary manner, and inoculated with the organism to be tested; a circle of about 15 mm. in diameter is cut in the center with the open end of a sterile test tube and the material inside the circle removed, leaving a circular hole, or cup, in the center. Into this space is inserted the preparation to be used in the test. The Petri dish is then placed in the incubator for twenty-four hours, after which time, sufficient growth will have taken place for the print to be made. It is then removed to a dark room and placed over a piece of sensitized paper[3] of suitable size and shape, about 1.5 to 2.0 meters from an electric light bulb of 75 or 100 watts, the Petri dish being between the paper and the light. Exposure is made for about ten to twenty-five seconds, but both time of exposure and distance can only be determined by trial. The print is then developed and fixed by the usual methods.

In figure 1 the agar plate was made by inoculation of organisms taken from the mouth, and prepared according to the technique of Himebaugh, described above. The light disk in the center is the area of the germicide, the dark zone is that of inhibition where no visible growth took place, and the mottled ring on the outside shows the growth of bacteria. The sharp line of division between the dark zone and the outer ring is a peculiarity of the material used in this particular instance. Figures 2, 3 and 4 were prepared in a similar manner.

[1] Hellige, Inc., New York, are manufacturers of this dish.

[2] Himebaugh, L. C., cited by Ruehle, G. L. A. and Brewer, C. M., U. S. Food and Drug Administration Method of Testing Antiseptics and Disinfectants. Circular No. 198, U. S. Dept. of Agriculture, 1931.

[3] Azo paper made by the Eastman Kodak Company serves very well for the purpose.

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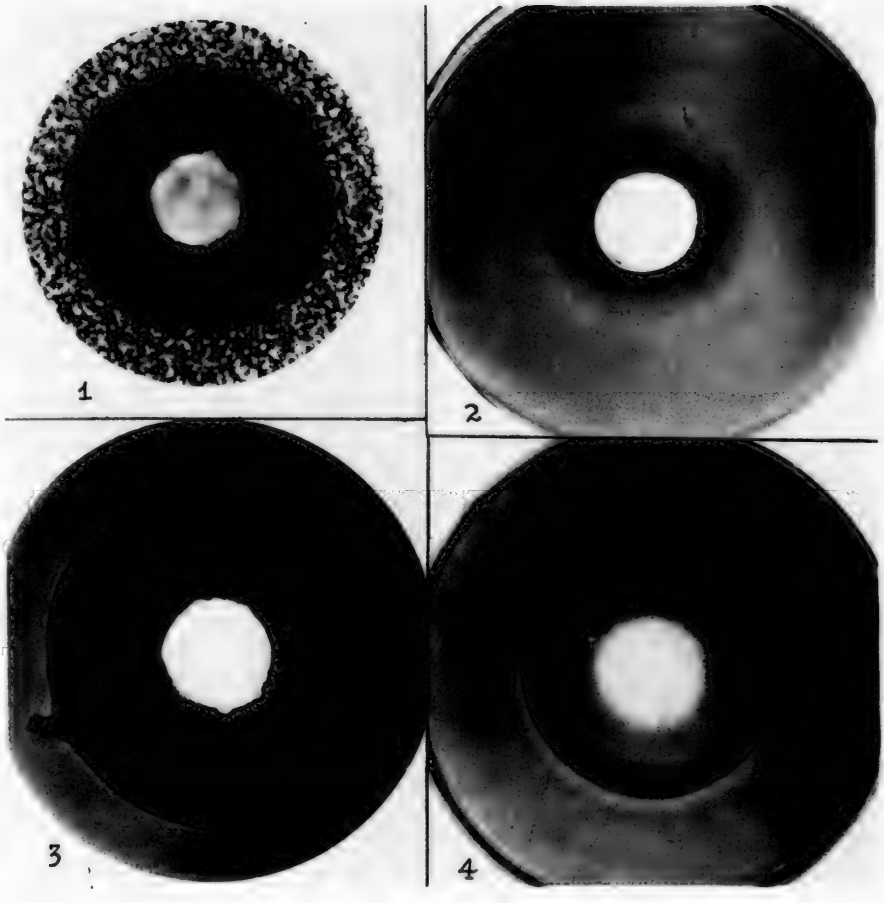

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CURRENT PHOTOGRAPHIC ABSTRACTS

J82–K/42

A Practical Method of Tricolor Toning. H. Swahn. *Amer. Phot.*, **31**: 316–19, May, 1937. Formulas and a procedure are described for producing a natural-color transparency or print by the toning method. One print is toned blue by converting it to Prussian blue (ferriferrocyanide); the second print is toned red by converting it to nickel dimethylglyoxime; and the third print is toned yellow by converting it to cadmium yellow (cadmium sulfide). R. A. P.

04–025

Photo-Drawing. L. Misonne. *Amer. Annual of Photography*, **52**: 187–91, 1938. In the process of photo-drawing, the negative is placed in the projector, a piece of paper is inserted in the easel, and the light portions of the negative are darkened to produce a uniform tone, thus yielding the drawing as a positive. Although work is easiest with a smooth-surfaced drawing paper and carbon pencils, a great variety of papers, and of pencils, chalks, and inks may be used. Control is possible in the suppression of backgrounds and in the correction of perspective by changing the relative size of objects. R. W. H.

0414–046

Removal of Scratches from Photographic Film. H. R. Crane. *Rev. Sci. Instruments*, **8**: 220, June, 1937. Unless some silver has actually been removed, elimination of bad scratches from 35-mm. film can be effected when enlarging by first placing a large drop of Canada balsam on each side of the film of the particular frame being treated, and then binding it between glass microscopic slides. E. R. B.

045

The Preparation of Nonphotographic Title and Diagram Slides. H. A. Robinson. *Brit. J. Phot.*, **84**: 680, Oct. 22, 1937. Glass can be prepared for drawing, painting, and lettering with India ink, oil color thinned with turpentine, or certain dye water colors, by giving it a very thin coating of Canada balsam. T. I. J. B.

X

Theory and Practice in Copying Radiographs. D. R. White. *X-Ray Technician*, **9**: 71–6, 107, October, 1937. The problem of tone reproduction in copying radiographs was studied sensitometrically. The process recommended consists in making an intermediate on a 5 by 7 commercial film, using a low contrast developer, for 8 minutes, and then printing this either on x-ray film or on a special translucent bore film. R. B. W.

043

Stereo Photography Comes to Life. R. H. Harrington. *Leica Photography,* **6**: 7, 18, August, 1937. A device is described for making stereo pictures with a Leica camera which consists of a metal holder containing two prisms, spaced about 70 mm. apart. The holder fits over the camera lens and produces two images in the space normally used for a single picture. Enlargements may be made for viewing in a stereoscope, or contact prints or original Kodachromes may be examined in a small stereo viewer. G. E. M.

228–S043

Stereoscopic Color Projection. B. Alfieri, Jr. *Amat. Phot.,* **84**: 507, Nov. 3, 1937. A brief description is given of the method of taking and projecting stereoscopic color pictures by means of a Leica camera with a stereo prismatic attachment. This latter is also used for projection, when it is fitted with polarizing screens, so that the two merged pictures are formed by beams of light with their vibration planes at right angles to each other. The projected images are thrown on a metal screen and viewed through polarizing spectacles. T. L. J. B.

2682

A New Meter for Color Exposures. R. H. Cricks. *Kinemat. Weekly,* **249**: 53–8, Nov. 4, 1937. A new photoelectric exposure meter, developed by E. Sanders, incorporates some novel features in design. The instrument is constructed on the principle of the reflex camera, a photoelectric cell taking the place of the sensitive emulsion. A mask located in the image plane restricts the light reaching the cell to that emanating from a portion of the image approximately 1 mm. square. Thus, the intensity of light reflected from highlights and shadows may be measured independently, and the necessary exposure derived from a chart, which also indicates the gamma required to obtain a given contrast. The usual microammeter is not used to indicate photoelectric output. Instead, the current is used to charge a condenser, which is then discharged through a time-integrating instrument. This enables the quantity of light to be measured, so that, for special purposes, the meter can be utilized to operate a shutter automatically when a predetermined exposure has been given. The meter has been designed primarily for color work, and is supplied with tricolor filters mounted before the lens on a turret head. A very high degree of accuracy, amounting to 0.1 per cent maximum error, is claimed for the instrument. G. J. C.

068

Possibilities of Stereoscopic Motion Pictures. G. W. Wheelwright, 3rd. *J. Soc. Mot. Pict. Eng.,* **29**: 603–13, December, 1937. A summary of the history of attempts at stereoscopic projection is followed by a discussion of the possibilities of Polaroid for this purpose. The chief advantage of this system is the fact that stereoscopic pictures in color are possible. C. T.

K094

The Visible World of Color. H. C. McKay. *Minicam,* **1**: 36–9, 84–8, September, 1937. Satisfactory photomicrographs in color may be obtained with an outfit costing fifty dollars, including camera and microscope. The use of polarized light, the choice of subjects, and the technique of the process are discussed. R. W. H.

Selected by permission of the Eastman Kodak Company from the Monthly Abstract Bulletin of the Kodak Research Laboratories.

CHATS WITH THE EDITOR

I. THE EDITOR TO THE PHOTOGRAPHER*

THIS is a fairy tale about a Medical Editor, a Medical Photographer and a Medical Author, who meet at the club to talk things over. You know at once that it is a fairy tale because in real life this never happens, beautiful as it might turn out to be. But, in all fairy tales, even the dumb animals are permitted to talk, wherefore the Medical Editor turns to the Medical Photographer and delivers himself of this monologue:

"I know that you are a good photographer, otherwise the Author would not have chosen you to illustrate his article. But all authors don't choose wisely, for authors simply don't know about photographers. Sometimes they choose them just as you choose your doctor, because the fellow has nice teeth, or somebody said he was all right, or more likely because he works for the University.

1) "So first be a good technician. Don't be satisfied with anything a whit below your best. So long as you say 'This ought to do' instead of 'That will take their breath,' throw it away. 'Photography has apparently reached a stage where good technique may be taken for granted' writes Edward Steichen in the *U. S. Camera.*

2) "Learn about reproduction processes in order that your prints may be suitable to them. Once you do this, you will never again—or at least *almost* never again—let your Author use for an illustration a contact print made from a lantern slide negative. (The exception may be made when the object depicted is small enough to be adequately shown on a 3 x 4 plate *in its finished state in the journal.* But watch the fine print!) Lecturers like to reproduce on lantern slides figures or even whole pages from books, to illustrate their talks. After the excitement of the presentation evaporates, nothing can induce them ever to lay eyes on the manuscript or the pictures again. The lantern

* The second of this series of chats, "The Photographer Talks to the Author," will appear in a subsequent issue.

slide prints are thrust with the (third carbon) copy of the manuscript into an envelope and sent to some journal. (The tiny prints fit so handily into an ordinary correspondence envelope!) Please, dear Photographer, don't let them do it.

A sharp, brilliant print of adequate size, thank you.

3) "Compose your picture. Available surface is limited by the page-size of the journal. If you waste it on clinic fixtures and the ample stripes of the supporting nurse, the small shaver with the terrible disease may never catch the eye of the paid subscriber.

4) "Whenever possible, ascertain the page-size of the journal in which your photograph is to appear, and let your print-size and proportion have some relation to it. Standard sizes from 4 x 5 to 8 x 10 are preferable.

5) "It is usually best to make all your reproductions of the same or similar sized objects in the same scale. The editor may wish to combine several prints in one layout, which is much more effective when some uniformity of treatment exists. If you care to refute this by citing the beautiful layouts which Mr. Louis Schmidt prepares for this JOURNAL, I can only retort that the scientific journals far outnumber the Schmidts. (That is, the *Louis* Schmidts.)

6) "Avoid a multiplicity of sizes, or at least of shapes, in your prints, for the same reason.

7) "The reader likes to keep his journal right side up. Owing to the nature of the subject matter, it is often necessary to print pictures right side to the top of the page with the legend at the long side, but it adds much to the appearance of the article if the illustrations can be all one way or the other.

8) "One can usually distinguish the top from the bottom of the pictorial photograph, and the artist runs a fair chance of seeing it right side up in the magazine. Not so the scientific print. To you and me a gall-stone looks much the same, any side up. But to the Inspired One who removed it—and is now writing its epitaph, with portrait, in the medical prints—it has its ups and downs, so please designate the TOP by writing it (with soft pressure so as not to show through) on the back. Please add the name of the customer, and yes, why not your own?

9) "Unless you are an expert letterist, please don't letter on the print. If the letters need to be actually on the print, get an expert to do it. Otherwise, draw projection lines to the edge and let the printer set it in type.

10) "There is no agreement among editors in the matter of mounting. Therefore, it is safer to send in your prints unmounted. If the old crank

wants them mounted he can mount them himself, but if by any chance he wants them *un*mounted, in order to combine them in a group, tearing them off the mounts is apt to be hard on the prints. Those glimpses of gray mount peeping out here and there between prints are bad, too. It is the worst possible practice to mount several prints together. Usually by the time this sticky patchquilt is reduced to a size that will permit it all to be crowded within the limits of the page, that little print in the corner will be tiny beyond recognition. Indicate on their backs the prints you would like to have appear together.

And finally, be tolerant of the author and the editor. Often you are the only professional of the three! For the medical author is usually only an occasional author; his main job is treating the sick, and if the fields of authorship are untrodden by him, what do you think he knows about reproducing pictures? Many medical editors, also, do it on the side. Some of them are pretty helpless with a pile of prints. Try and make yours fool-proof, or shall we modify it ever so slightly and say editor-proof?"

ARTHUR W. PROETZ, M.D.
Editor of the *Annals of Otology, Rhinology, and Laryngology.*

"Photography is both an art and a science; it is an invaluable tool to those working in the other arts and sciences, and there are few activities of civilized man in which it has no part.

"To those who are watching the contemporary scene, the development of any art or science sometimes seems to proceed at a very variable rate, halting in its progress from time to time, only to burst forth again with renewed energy. But this is probably only an impression produced in the mind of the observer. In retrospect, the progress will appear far more uniform than it seemed to be at the time. Actually, the development of photography has never come to a standstill, and every year has seen changes, large or small, which have carried the seeds of still greater changes. Thirty years ago, I found it hard to conceive that great improvements in the art of photography were possible; to-day, I am certain that still greater improvements are imminent.

Selected from the Preface of Photography *by C. E. Kenneth Mees.*

PHOTOGRAPHIC TECHNIQUE, NEW PROCESSES, AND EQUIPMENT

F. R. HARDING*

Processing Room Illumination

THE average processing room is not properly illuminated for developing purposes, or for general white light. Many safelights are unsafe due to minute cracks in the safelight caused by age. All safelights should be examined at frequent intervals and as soon as a crack appears the safelight should be discarded. Some varieties of safelights change color after a considerable period of employment. This change is often associated with excessive heat due to continuous lamp burning, with poor or no ventilation of the safelight house. Mysterious fogging of sensitive material is sometimes due to this change of color.

Employment of larger lamps than those recommended by the manufacturer for a specified distance, or use of the safelight lamp very close to the sensitive material, are both prolific causes of general fog. Judgment upon the part of the user of the safelight is necessary.

The following test should be made for each safelight: First, with the safelight in operating position, the light turned out, and the test material in the position in which it is usually handled or developed, expose one third of the total area of the sensitive material for 30 seconds in the dark. Cover this third and expose the middle third for 30 seconds with the safelight turned on. Do not expose the last third in any way. Develop and fix the material and check the first third; if any fog shows here, it is caused by light leaking into the processing room from outside sources. Examine the middle third, if fog shows here, the safelight is unsafe and a lower powered lamp should be employed, or the safelight replaced with a new one, or the safelight lamp should be placed farther from the sensitive material. If fogging shows on the last third, it is caused by the developer, and this should be investigated. Development of this test should be conducted in total darkness by time and temperature, and the tray should be covered at all times. Many interesting matters are sometimes brought out by this test. It should be made for every different safelight used. The test should be repeated once each year.

The white light illumination of the processing room is frequently poor. It

* Received for publication January 21, 1939. Children's Hospital, Boston, Mass.

does not often consist of more than one fixture, usually placed in the center of the ceiling and containing one low powered lamp. There is no reason why plenty of white light cannot be employed. It is better to over-light the room than to under-light it. When the latter is the case, it is difficult to find articles needed for use, stain and insufficient fixation are not readily observed, etc. The writer employs a 250 watt lamp in a suitable reflector hung from the ceiling, and also uses a small illuminating box fastened to the back of the sink. This box has a slanting front. It contains a 50 watt lamp, diffused by flashed opal glass, and is very useful for examining lantern slides and prints, and for general white light illumination of the sink.

General safelight illumination for the processing room should consist of an indirect lighting box suspended from the ceiling. Most boxes of this type have two compartments and allow safelights to be employed for orthochromatic and panchromatic film. Separate wall switches for each compartment must be installed. It is most important to use switches of two distinct types, such as a snap switch and a toggle switch, so that there will be no doubt as to which safelight is being turned on. Individual safelight lamps should be placed in the position most advantageous for illuminating developing trays, tanks, loading benches, etc.

A small box containing the different safelights necessary for the various materials employed should be placed close to the safelight lamp most frequently used.

Safelight lamps can be purchased in a variety of shapes and sizes. Some screw into an electric wall socket, others stand on a shelf and are pivoted so that the light may be directed up or down. A very useful type screws into a pendant socket. If this type is employed, the electric cord should be adjustable so that the light will not be directed into the operator's eyes. Another type is a rectangular box placed on a shelf. It has the safelight in the lower half of the front, the upper half being of opal or ground glass which is supplied with an opaque shutter. This cuts off all the white light when it is not desired. Photographers sometimes employ ordinary red electric light bulbs for red light illumination. This is permissible *if* the red lamp is sold by a reputable photographic stock house. These lamps are made of a photographically safe red glass and may be purchased in several degrees of intensity. *The ordinary red lamp which is dipped in dye is not safe for photographic use.* The new rapid panchromatic materials *must* be handled in total darkness throughout all operations. These films are so rapid that no safelight which will emit enough light to be useful can be employed without producing fog. Some causes of fog would be eliminated if all film processing operations, including loading and

unloading of holders, were conducted in total darkness, with development of the films by time and temperature.

New 800-Foot Continuous Attachment for Motion Picture Projectors

Announcement is made by Bell & Howell of a new 800-foot projector attachment. It provides greater showing capacity than models hitherto in use and incorporates several new features.

To eliminate friction between the film layers the attachment is mounted in a horizontal position. The edge of the film thus bears the film weight. The design is such that the convolutions of film are caused to spread apart from one another, making the film run loosely in the attachment.

In addition to reducing friction between the layers and decreasing the tension on the film at the sprockets, the looseness of the film on the reel provides means for taking up variations in the overall length of the film due to shrinkage and to varying degrees of humidity.

If the film should become either torn at the perforations, or broken anywhere throughout its length, the projector is instantly stopped by the automatic protective switch supplied with the attachment.

To further increase film life a substantial cover has been provided to enclose the reel entirely excepting openings necessary for the film to feed in or out. The possibility of film scratching due to dirt and grit in the air is thus minimized.

The new B & H 800-foot Continuous Attachment is for use with 16 mm. films, either sound or silent. Eight hundred feet of sound film, at 24 frames per second, provides a 22 minute showing; silent film at 16 frames per second provides a 33 minute showing; silent film at 16 frames per second provides a 33 minute showing, before repeating.

The continuous attachment is now supplied for Filmo silent projector models 57 and 129, and for Filmosound models 120, 138 and 142 with the exception of the variable resistance models.

Two New Slide Projectors Announced by Spencer Lens Company

A new projector for 2″ x 2″ and 3¼″ x 4″ color slides is being produced by the Spencer Lens Company of Buffalo, New York. It will project a 2″ x 2″ slide with greater brilliance than does the usual 1000 watt auditorium projector with a 3¼″ x 4″ slide. This projector is known as Auditorium Projector Model GK.

So intense is the illumination available that an iris diaphragm is sometimes needed to control the light on the screen when using thin slides or projecting to small gatherings.

It is offered three ways: for 2″ x 2″ slides only, for 3¼″ x 4″ slides only, and for 2″ x 2″ and 3¼″ x 4″ slides. The only difference is in the optical units, which can be exchanged in a few seconds.

The projector is equipped with a 750 watt lamp, cooling fan, a three element condensing system with heat filter, and projection lens. Lenses range from 6½″ to 10″ in focal length.

This company also is producing another new projector for 2″ x 2″ slides only, with deliveries beginning January 20.

The new instrument will be known as Model MK Delineascope, and the basic unit will be priced at $22.50. The manufacturers claim this 100 watt projector is very efficient, that it will remain cool enough to handle at all times, and assure safety for color films.

Accessory equipment will be available. Increased illumination will also be available for use in class rooms.

The projector lens is of 5″ focal length, and the instrument has a self-leveling elevating device held by a knurled thumb screw. The lamp house is hinged, permitting easy access to lamps and condensers.

A New X-Ray Processing Room Safelight

More films are ruined in the processing room than are spoiled by improper exposure or other technical errors. Much of this loss results from fumbling in the semi-darkness of dim safelight illumination. Thus radiographers will welcome a newly developed safelight especially for use with x-ray film, which transmits many times more visible light than the now widely used Eastman-made Wratten Safelight, Series 6A.

The new product is the Wratten Safelight, Series 6B, just announced from Rochester by the Eastman Kodak Company. Used in a direct-type safelight lamp, the Series 6B Safelight transmits ten times more useful light than the older 6A, and with indirect-type safelights, sixty times as much illumination is provided.

With the new Wratten Safelight, Series 6B, every operation in the manipulation and processing of x-ray film may be performed by "sight" rather than "touch." Eyestrain is minimized, and working conditions are improved. The pleasanter darkroom atmosphere alone justifies the slight cost of installing the new Series 6B Safelights to replace older, less efficient, safelights.

ASSOCIATION NEWS

Please Note!

IT is early—but not too early—to talk about the 1939 Convention. The Committees are already at work on program and accommodations; and we hope you, on your side, are making plans to join us in Pittsburgh next September. The June issue of the Journal will carry definite information about meeting headquarters and dates, and preliminary data on the program. Committee Chairmen are as follows:

Arrangements, Mr. Chester Henry, Falk Clinic, Pittsburgh, Pa.
Program and Publicity, Miss Anne Shiras, Magee Hospital, Pittsburgh, Pa.
Salon, Mr. Albert Levin, Montefiore Hospital, Pittsburgh, Pa.
Chapter, Mr. Graham Netting, Carnegie Museum, Pittsburgh, Pa.

We will have, in addition, a Regional Committee made up of members from various sections of the country, who will keep their eyes open for good program and Salon material. These members will be announced later. The Publicity Committee will see to it that everyone interested in scientific photography in Pittsburgh and its environs hears about the Convention, and that programs will be available in advance for all who want them.

Biological Photography in Bombay

Our first member from India is Mr. Shriram Deshaprabhu, who joined the Association last fall. In response to a letter asking about his photographic interests, he wrote from Washington, D. C.:

"I have just finished a two year course in medical art with Professor Brödel of Johns Hopkins University. Before I leave this country I am going to several places to see the latest advancement in biological photography. I have been to the Yale Medical School and am at present at the Army Medical Museum. I will visit the following places very soon: Rockefeller Institute for Medical Research, State Institute for the Study of Malignant Disease, Mayo Clinic, Veterans' Facility, and so forth. . . .

"As I am Art-Director in our Hospital in Bombay, the Department of Art and Photography comes under my Chair. I hope to do photomicrography in cancer research, on a large scale.

". . . I will keep in touch with you from Bombay in writing you all about my photographic work there. Thanking you for your fine co-operation. . . ."

We wish Mr. Deshaprabhu every success in founding his department, and urge him to carry out his promise of keeping in touch with us.

Introductory Note

The name of Dr. Hans Elias, one of our authors in this issue, is well known on the Continent, but may be new to our readers. It appeared in an earlier issue of ours (Vol. IV, No. 4, June 1936, last page) in a description of the second congress of the "Association pour la Documentation Photographique et Cinematographique dans les Sciences," held in Paris. At this meeting, according to our notice, Dr. Elias "talked on the development of flowers, emphasizing a technique for photographing the development with a film, by making a schematic representation and then employing direct photography."

Dr. Elias received the degree of Doctor of Philosophy in the branches of Zoology, Botany and Anatomy; and in the same year, 1931, qualified as a teacher, in the Superior Schools, of Zoology, Botany, Mathematics and Physics.

As a means of forwarding the scope and technique of this type of work, he helped in the formation of an international Editorial Board, to publish an authoritative journal on scientific cinematography. Such a Board was actually formed, under the auspices of the League of Nations.

The withdrawal of Italy from the League and the unsettled conditions in Europe disrupted this plan before the Board could commence publication. It is to be feared that Dr. Elias' other interesting projects will also be blocked by the European situation.

Chapter Reports

Because their members are concentrated in one locality, and can hold meetings often enough to keep the ball rolling, local chapters are in a position to make a real contribution to the work of the Association. We hope their secretaries will keep in touch with each other, and with the national secretary, as an exchange of ideas will benefit us all.

Boston. Judging by the reports, this Chapter is having a busy winter. At the October meeting, Mr. Alton H. Blackington loaned the Chapter his Kodachrome slides of the 1938 tidal wave and hurricane. These presented a dramatic story of the hurricane's wake, from Falmouth to New London. In

November Mr. Gerrison of the Defender Photo-Supply Co. gave a demonstration of Chromatone printing. Some enterprising member took candid shots at this meeting and assembled them into a photomontage in which we find the faces of many old friends, looking extremely alert and interested. In December Mr. Corcoran of the Gellotta Claus Co. demonstrated the Graflex Photo-Record Camera; and Mr. Waldman of the Eastman Kodak Store introduced the new E.K. 16 mm. Sound Projector with the E.K. film "Highlights and Shadows." The Chapter attended two sessions in January: one at M.I.T. in which Mr. F. Lucas of the Bell Telephone Laboratories spoke on "Modern Methods of Microscopy in Industry and Science"; another at the Harvard Dental School where Mr. Stillman Powers spoke on "Lantern Slide Technique."

New York. A reorganization meeting was held on January 20th at Squibb Hall. Mr. Louis Schmidt, President of the Association, acted as temporary chairman and a number of topics for the good of the Chapter were discussed. Among these was the possibility of holding the 1940 National Convention in New York City. Various plans for increasing the membership were discussed and the Chairman was authorized to appoint a Committee to cooperate with some of the representatives from optical and supply houses in bringing the activities of the Chapter before a larger group of interested photographers. The following Committee was appointed: Dr. Sydney E. Riesner, N. Y., Chairman, Dr. Hyman Strauss, Brooklyn, Mr. Francis Johlfs, Brooklyn, Mr. Adolph Marfaing, N. Y., Mr. Leonard Perskie, N. Y., Mr. William Schanzenbach, N. Y. This diversified committee, consisting of a dentist, a gynecologist, an X-ray technician, a photographer, a demonstrator, and a laboratory photographer should be able to reach a wide range of photographers. The sum of $30 was appropriated to print leaflets explaining the purpose of the Chapter. It is intended that these leaflets will be enclosed in the correspondence of our commercial members in order to publicize the meetings. Mr. S. A. Robbins of Camera House was appointed Chairman of the Program Committee, with Mr. John Brooks of E. Leitz Co. as assistant.

After the business meeting prints from the 1938 Salon were shown for discussion. Mr. John Brooks also showed his candid shots taken during the Philadelphia Convention. Those taken at the banquet had some interesting but weird effects, owing to the fact that the room was mirror-lined.

Philadelphia. We are not fully informed on the programs, but we know that in December Mr. William Rittase, commercial photographer, compared various types of enlarging equipment and discussed the difference between the diffusion type of light and condenser illumination in enlarging equipment.

Mr. Burton, Secretary of the Chapter, writes "we have decided to have, as a

standard portion of our program, a question and answer period for those members who have some specific problem that they would like to place before the group. We also plan to have a short period for discussion of new photographic items."

Pittsburgh. Mr. William Warren of the Fisher Scientific Co. gave a demonstration of micro-film equipment at the November meeting; Mr. George Henneman projected a varied series of slides ranging from photomicrographs to scenic shots in black-and-white, and color. In December Dr. Arthur C. Twomey showed his natural color moving pictures of an expedition into the interior of Ungava and the Belcher Islands, describing the difficult conditions under which the pictures were taken. At the January meeting Dr. James Kinder of the Pennsylvania College for Women showed three Erpi 16 mm. sound-on-film subjects: "Body Defenses Against Disease," "Digestion," and "Reproduction in Mammals." In February Mr. Luke Swank, Pittsburgh photographer, hospitably invited the group to his studio for a session on printing and enlarging. The first Wednesday of the month is Pittsburgh Chapter night, and we follow Philadelphia's example in meeting for a "Dutch Treat" dinner before the program.

Report of the Committee on Motion Pictures

"Rutgers Films." The Department of Biophotography at Rutgers University, New Brunswick, New Jersey, is engaged in the production and distribution of films covering subjects in botany, paleontology, psychology, medicine and surgery, veterinary science and zoology. Mr. Charles D. June, Business Manager, advises that they are also in a position to market educational films of other producers.

Films by Members reported in 1938.

Baker, C. L., c/o Southwestern, Memphis, Tennessee. *Marsh birds* in color.

Bergman, Lester V., 715 Eastern Parkway, Brooklyn, N. Y. 1. *Sterility.* 2. *Trichomonas vaginalis.* 3. *Allergy.* In color.

Brues, C. T. Biological Laboratories, Harvard University, Cambridge, Mass. Pictures on insects, Rafflesia blossom and scenic and scientific pictures of the Dutch East Indies.

Claff, C. Lloyd, 5 Van Beal Rd., Randolph, Massachusetts. *Colpoda cucullus —Phenomena of Excystment.* 16 mm. silent.

Johnson, Myrtle E., 4647 Fifty-fifth St., San Diego, California. 1. *Horseshoe crabs.* 2. *Fiddler and sand crabs.* 3. *Seashore animals* (rocky beaches). 4. *Seashore animals* (muddy beaches). 16 mm.

Morris, Robt. C., Jr., E. B. Meyrowitz, Inc., 732 Fifth Avenue, New York City. Constructing new easily operated clinical miniature camera.

Pearson, Miss Gertrude R., Child Research Council, 4200 East 9th, Denver, Col. Posture series on C. R. C. children. Kodachrome.

Riesner, Dr. Sidney E., 136 E. 36th St., New York City. Animation of serial X-ray study of jaw joint. 16 mm.

Roger, Henry, Sandy Hook, Connecticut. Two films on *Pneumonia* for New York State. *Skin photography.*

Sharp, Robert R., Wrentham State School, Wrentham, Mass. Color cinephotomicrography.

Walp, Lee, Marietta College, Marietta, Ohio. *Life cycle of Obelia.*

Inquiries regarding the availability of these films should be addressed directly to the photographer as the Committee has no information on availability.

Material for future listings should be sent to the Secretary of the Association, Miss Anne Shiras, or to the Chairman of the Committee at 19 Doat Street, Buffalo, New York.

K. K. Bosse
Jean Kieffer
Oscar W. Richards, *Chairman.*

New Members

We take pleasure in announcing the following new members:

Benedek, Tibor, M.D., 25 East Washington Street, Chicago, Illinois.

Billings, R. J. (M.D.) (*Pittsburgh Chapter*), Jenkins Arcade, Pittsburgh, Pa.

Eskridge, Miss Lydia C., Warner Institute of Therapeutic Research, 113 West 18th St., New York, N. Y.

Hartwell, Katharine (*Ralph P. Creer*)**, 1446 Fairmount Avenue, St. Paul, Minn.

Hatch, Ray D. (*H. L. Foust*), Ames, Iowa.

Henneman, G. L. (*Pittsburgh Chapter*), 754 Wallace Avenue, Wilkinsburg, Pa.

Hershenson, Morris A., M.D. (*Pittsburgh Chapter*), 3401 Fifth Avenue, Pittsburgh, Pa.

Hodgkiss, James, M.D. (*Dr. T. Helmbold*), 223 Boggs Avenue, Pittsburgh, Pa.

Huber, William, M.D. (*Pittsburgh Chapter*), Jenkins Building, Pittsburgh, Pa.

Mayer, Arthur E. (*Pittsburgh Chapter*), Beaver, Pa.

McCombs, Miss Lois (*Pittsburgh Chapter*), 1205 Farragut Street, Pittsburgh, Pa.

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The Journal of the
Biological Photographic Association

Volume 7 June, 1939 Number 4

ELECTROGRAPHY

S. PRAT, PhD. AND J. SCHLEMMER, Ph.D.*

THE Czech physicist, Professor B. Navrátil, is discoverer of the method of electrography. The principal information regarding the method is cited in the book by Wolf-Czapek, *Angewandte Photographie in Wissenschaft und Technik*, 1911. However, only the principles of the method are described and no information is given concerning applicability of this type of photography.

* Received for publication January 20, 1939. Plant Physiology Laboratory, Charles University, Prague, Czechoslovakia.

Explanation of Opposite Plate

Figures 1–15, except 12. Electrographies made with an inductor, k_2 connected with the object. Sparking distance 20 to 30 mm. All leaves were alive except figure 7.

Figures 1–2. Czechoslovak coin, 10 h, slightly enlarged; actual diameter 18 mm.

Figures 3–5. Leaves of Hedera helix.

Figure 3. Distance k_1 to k_2, 2 mm. Exposure 10 sec.

Figure 4. Distance k_1 to k_2, 50 mm. Exposure 30 sec.

Figure 5. Distance k_1 to k_2, 100 mm. Exposure 30 sec.

Figures 6–7. Tradescantia zebrina, living and dried leaf.

Figure 6. Tradescantia zebrina. Distance k_1 to k_2, 2 mm. Exposure 10 sec. Shades of single cells visible.

Figure 7. Tradescantia zebrina, dried leaf. Between k_1 k_2 glass 6 mm. thick. Exposure 30 sec.

Figure 8. Hedera helix. Between k_1 k_2 5 mm. air and 5 mm. thick glass plate. Exposure 60 sec. Between leaf and emulsion on the left side aluminium (sheet 0.1 mm. thick), on the right side xylonite 0.2 mm. thick. The corona from the Al and from the tip of the leaf diverging. The radiation is going through the sheet of xylonite.

Electrography consists of making contact prints of various objects placed directly on the photographic emulsion in an electrical field during the electric discharges. The main apparatus is an inductor. A plate made of sheet iron about 13 x 18 cm. is placed on an insulated wooden stay and is connected with a contact of an inductor and forms one plate of a condenser. Upon this a larger cardboard and a glass plate are placed, upon which rests the photographic plate or film. An object such as a medal or a plant leaf is placed upon the sensitive film in contact with the emulsion, thus forming the other plate of the condenser. A vertical wire is placed over the object touching the upper surface thus connecting it with the second pole of the inductor. The arrangement of the apparatus used in our experiments is shown in figure 1.

A storage battery of 4 volts, 1.8 to 2.5 amperes or an intermittent current modified by a transformer of 10 to 20 volts, 2 amperes, supplies the primary circuit operating the inductor. The length of the spark in the secondary circuit reaches 15 to 25 mm. indicating a tension of 15,000 to 25,000 volts. The length of the spark mentioned in the paper was the distance between the discharge points of the machine as in the experiments by Nipher. Obviously, the sparking points were not used during the time of exposures.

Various kinds of photographic material were used: plates, films, papers, and diapositive plates. The Foma Opus Brilliant plates were most generally employed. The time of exposure varied from 5 to 60 seconds. All experiments were made in a dark room with red light; no changes were observed if the exposures were made in completely darkened rooms. A metol hydrochinon developer was used, the time of development being from 2 to 3 minutes.

Explanation of Opposite Plate

Figure 9. Acer platanoides k_1 k_2 2 mm. Exposure 10 sec.

Figure 10. Acer platanoides. Between k_1 and k_2 a glass plate 10 mm. thick.

Figure 11. Quercus robur. k_1 k_2 2 mm. Exposure 10 sec.

Figures 12–13. Aucuba japonica.

Figure 12. A contact print on the plate made with a Philips lamp.

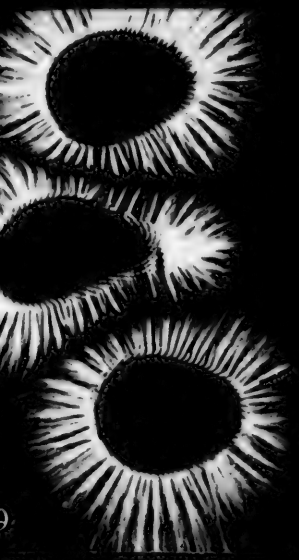
Figure 13. The same leaf as in 12, electrographed. k_1 k_2 2 mm. Exposure 10 sec. The necrotic spot made with a drop of chloroform does not transmit light but disappears in the electrography.

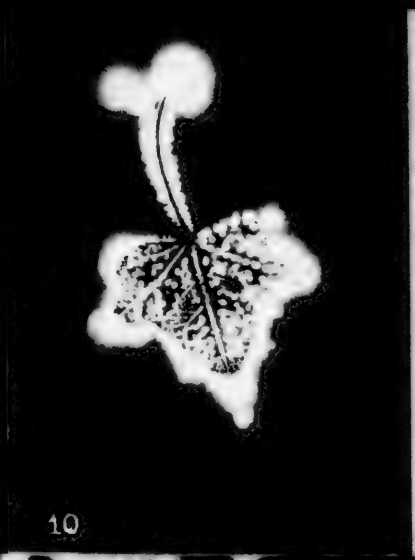
Figure 14. Graminea. k_1 k_2 2 mm. Exposure 10 sec.

Figure 15. Hedera helix. Between k_1 k_2 a glass plate 10 mm. thick. Exposure 20 sec.

Figure 16. Hedera helix. Between k_1 k_2 a glass plate 5 mm. thick. Exposure 10 sec., the minus pole connected with the leaf.

Figure 17. Electrography made with an influence machine; print and radiation of fingers.





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With higher tension of the current, sparking or glimming on the edges of the objects is observed, while with the lowering of the tension in the primary and secondary circuits, the effects diminished.

Mostly positive discharges (k_2), figure 1, were used in our experiments with the result described below. "The negative discharge shows much less interesting detail. With short sparks, there is a smooth corona, looking like a brush shading in India ink. With longer sparks some radial line-work, suggesting lines of force, appears." Nipher, p. 154.

In all cases the electrographies show a very characteristic corona around the objects with many variations in the detail of the pattern. Our results are about

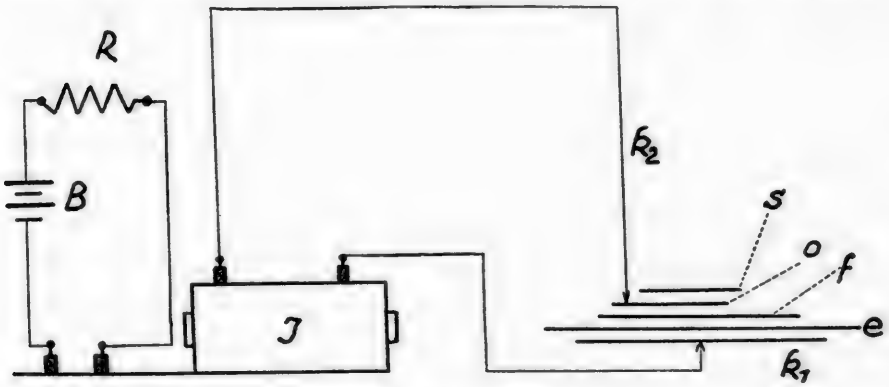

FIGURE 1.

B—storage battery; R—rheostat; I—inductor; k_1 k_2—wire connecting the inductor with the object and with the lower sheet iron; e—paper (cardboard); f—photographic plate or film; o—object (leaf); s—glass plate.

the same as those shown by Wolf-Czapek I. (Taf. 8. Figures 32 to 34) and by F. E. Nipher in the Transac. of the Academy of Science of St. Louis 10:151–166, 1900, Plates XII–XVI. Points, tips, and sharp edges of objects, especially show the strongest radiation.

In experiments done by previous authors only metals which are good conductors were used. But in our experiments living tissues such as plant leaves proved to be very good material for electrographing. Leaves from various plants supplied excellent electrographs. A detailed description of the pictures cannot be given here. However, some examples are reproduced in plate 1 which demonstrate the character and details obtainable with this type of photography. The edges of the objects photographed are surrounded by a strik-

ing corona of varying density and pattern. Note the reproduction of the structure of the surface which is in contact with the photographic emulsion. The distance between the photographic emulsion and the object to be electrographed is very important. Areas which are in closest contact or pressed to the surface of the emulsion are not recorded on the photographic plate. Structures which are not in contact with the emulsion and are away from the emulsion a fraction of a millimeter produce the most interesting prints; if this distance is increased, sharp prints cannot be obtained. If the surface of the object is removed 2 to 4 mm. from the emulsion, the blackening of the plate is not produced, for only the edges of the object are sending sparks to the surface of the emulsion. Therefore, the corona surrounding the image of the object is produced and the shade of the smooth surface of the object disappears. Elevations on the surface of an object are centers of sparking. Their position therefore is shown by the spots caused by the corona as indicated in plate 1.

No differences were observed in the reproduction of living or dead tissues; only dried parts of leaves showed much lower or no radiation, probably because of the decrease of electrical conductivity.

From the biological standpoint it is important that the leaves remain alive while experimenting with lower voltages. With higher voltages, localized areas of necrosis, burning, appeared in the areas which were in contact with the wire during the exposure or some hours later. But the damage was slight for the lamina even in isolated leaves survived.

There can be no doubt about the complex nature of the radiation pictured on the photographic material. The visible and ultraviolet rays are present in the sparking as shown by spectrographic examination. But experiments with different screens, or filters placed between the object and the emulsion, showed that another kind of radiation must be present. Especially the screens of xylonite, an English fabric, which is impermeable to infra-red, visible and ultraviolet radiation, did not hinder reproduction of the corona. However, more information about the nature of this radiation cannot be given until further studies are made.

There is no doubt that the various, direct or indirect, photographic methods are superior to the electrographic method in yielding better reproduction of surface detail. However, with biologic material, electrography is of definite value in recording the spreading out and localization of densities of electrical discharges, while in some cases, electrography can be an aid in studying the structures of the surface. This is especially true in the field of metallography when the examination of the structure of surfaces is under consideration.

INTESTINAL TRANSPARENCIES

JOSEPH FELSEN, M.D., AND THOMAS E. ROSS*

IN examining fresh intestinal necropsy material by reflected and transmitted light one is struck by the variety of lesions revealed by this method. It has really opened up a new and fascinating field in the demonstration and interpretation of intestinal pathology. Since the moist, opened bowel is highly translucent, the light of a 75 or 100 watt bulb is sufficient to make the intramural structures stand out with startling clarity.

Technic. The intestine, which has been removed from the body by cutting its mesenteric attachment, is opened along the mesenteric border. It is at this point that the vessels enter and branch to encircle the bowel wall, finally sending their terminal arborizations into the mucosa and solitary acuminate lymph nodules. The latter are of particular interest because of their intimate relationship to the blood vessels and their protective role in absorbing toxic substances located within the lumen of the bowel or brought to them by the blood stream from other parts of the body. The delicate filamentous network of blood vessels embraces and penetrates each nodule sending many branches into its substance to assure intimate contact with the lymphoid tissue. We have referred to their mechanism elsewhere as the Indirect or Hematogenous Excretory Mechanism of the body.[1]

In actual practice the opened, washed intestine is examined by the aid of the intestinal illuminator[2] which is essentially a translucent glass plate mounted in a wooden stand with electric bulbs below and above it. The intestine passing over the plate is viewed alternately by transmitted and reflected light. The structures or pathology viewed by this method may be briefly summarized as follows:

A. By reflected light: Peyer's patches, focal lymphoid hyperplasia, projecting tumors, ulcers, varicosities, melanosis.

* Received for publication February 27, 1939. From the Department of Laboratories and Research, The Bronx Hospital, New York, N. Y.

[1] Felsen, J., Intestinal manifestations of systemic disease, *Rev. Gas. Ent.*, 5:114 (June), 1938.

[2] Idem, Intestinal illuminator. A device for detecting intestinal lesions in post-mortem specimens by reflected and transmitted light, *J. Lab. and Clin. Med.*, 21:923 (June), 1936.

B. By transmitted light: Blood vessels, vascular and perivascular lesions, emboli, focal necroses, intramural abscesses, infiltrating tumors, small intramural tumors (e.g. leiomyoma), early lesions in Peyer's patches, leukemic infiltrations.

Selected areas of the bowel chosen for photography are then flattened on the upright glass plate of an illuminating box such as is used for viewing X-ray films. The light around the specimen is completely blocked out with black paper. The intramural structures of the bowel stand out clearly and are photographed on commercial ortho film by the usual standard exposure, approximately 8 to 10 seconds, with the diaphragm stopped down to approximately f:16. Our permanent arrangement is a viewing box and Eastman Clinical Camera lined up on a high table with tracks permitting position adjustment of either light or camera.

The intestinal illuminator may be used for photography by spreading the opened bowel upon the horizontal plate. It has the advantage of enabling the photographer to use either transmitted or reflected light, depending upon the type of pathology present, by merely pressing the appropriate switch. Fresh intestinal specimens adhere to glass easily in either the horizontal or vertical position. In taking photographic translucencies it is important to smooth out any air bubbles or folds imprisoned between the specimen and glass.

Interpretation. Perhaps the most interesting phase of this work has been in the study of vascular intestinal pathology. Physiologic as well as pathologic variations have been noted and correlated with clinical and histopathologic examinations. The sigmoidoscopic appearance of the vessels as seen by re-

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EXPLANATION OF FIGURES

Figure 1. Intestinal illuminator.

Figure 2. Normal mesenteric vascularization of intestine.

Figure 3. Focal hemorrhagic necrosis of intestine in pharyngogenic hematogenous streptococcic peritonitis. Viewed by reflected light.

Figure 4. Same area as illustration 3, viewed by transmitted light. Note location of hemorrhagic area (arrow) at end of blood vessel, which is necrotic.

Figure 5. Arteriosclerosis. Note corkscrew undulations.

Figure 6. Arteriosclerosis, advanced stage with straight, rigid vessels and obliteration of terminal branches.

Figure 7. Meningococcus septicemia. Note hemorrhages (arrows) and surrounding of Peyer's patches in ileum by blood vessels.

Figure 8. Tiny emboli (arrows) in mesenteric branches in case of staphylococcic bacteremia.

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flected light during life is comparable with translucencies of necropsy specimens since in the former the vessels are filled with circulating blood and can be accentuated by the aid of the green filter.[3] The normal delicate sinuous undulations of the quickly responsive, elastic and gradually tapering vessels of youth are replaced with advancing age by the sharp, corkscrew, rigid angulations of the sixth decade and finally by the short, straight vessels with obliterated arborizations of senescence. It is fascinating to note how accurately these intramural mesenteric vessels reflect the general condition of the blood vessels of the body. One of us (J. F.) routinely examines the retinal vessels of patients before sigmoidoscopy since they are of approximately the same size and exhibit a pathology similar to that shown by the mesenteric vessels in the bowel. Study by transmitted light at necropsy has enabled us to interpret lesions seen during life. In subacute bacterial endocarditis, an almost universally fatal disease, we have been able to demonstrate petechiae (embolic) *within* the small mesenteric branches before they have appeared elsewhere. Corroboration has been obtained in individual cases by finding the lesions by transillumination exactly where and as described during life. Similar embolic lesions have been noted by us in meningococcus, pneumococcus 7 and staphylococcus aureus septicemias. Linear thromboses of the submucosal vessels have been demonstrated in three cases of periarteritis nodosa. In lead poisoning tiny particles of insoluble lead sulphide are deposited along the mesenteric vessels. One interesting feature of the necropsy examination has been the uniformity with which many of these lesions are entirely missed when viewed solely by reflected light. The intestinal transilluminator has enabled us to accumulate a mass of interesting pathological material which we have photographed as described for our museum, for teaching purposes and for direct practical application in the diagnosis and treatment of intestinal disease.

[3] Idem, Clinical notes on the use of color filters in sigmoidoscopy, *Am. J. Dig. Dis. and Nut.*, 5:38 (March), 1938.

DUAL CAMERA MOUNTING FOR GROSS SPECIMEN PHOTOGRAPHY

S. J. McCOMB*

THE advantages of color in gross specimen photography, plus the low cost of color film in the 35 mm. size, has been a great stimulus to photography of this type. However, when a black and white negative of the same subject in a larger size must be made, particularly for publication purposes, there is attendant fussing with the changing of the camera and light set-up. To obviate this a camera extension arm was devised which will be described.

As seen in the illustrations, the camera is in a vertical position, and has a rack and pinion focusing front. A wooden extension arm, notched in two places, slips on the camera front. On the front side of the arm, to which is attached the miniature camera, are triangular brackets just above the notches, which lend stability to the entire assembly. On the bottom, at one end of the extension arm, is a short strip of stiff metal the width of the arm, which turns on a bolt fitted with a wing nut. At the other end is fastened, by means of a tripod screw or ordinary bolt, a block especially designed for mounting the ground glass focusing device.

In operation the metal strip on the extension arm is swung aside to aid in placing the arm on the 5″ x 7″ camera front, then it is righted and locked in place with the wing nut. The notches and angle brackets keep the assembly rigid as it is raised or lowered on the camera front. A quick shift of the gross specimen brings it under the miniature camera. Ordinarily no change in the lighting is necessary. The arm is lowered by means of the rack and pinion on the 5″ x 7″ camera, and focusing of the miniature is done in the usual manner.

A longer focal length lens on the miniature camera would eliminate the need for as great a change in the object to lens distance (as is the case when using the 50 mm. lens) when making the shift from the 5″ x 7″ camera to the miniature.

No specific dimensions have been given, as it is the purpose of this article to describe a method flexible enough to be adapted to varying requirements.

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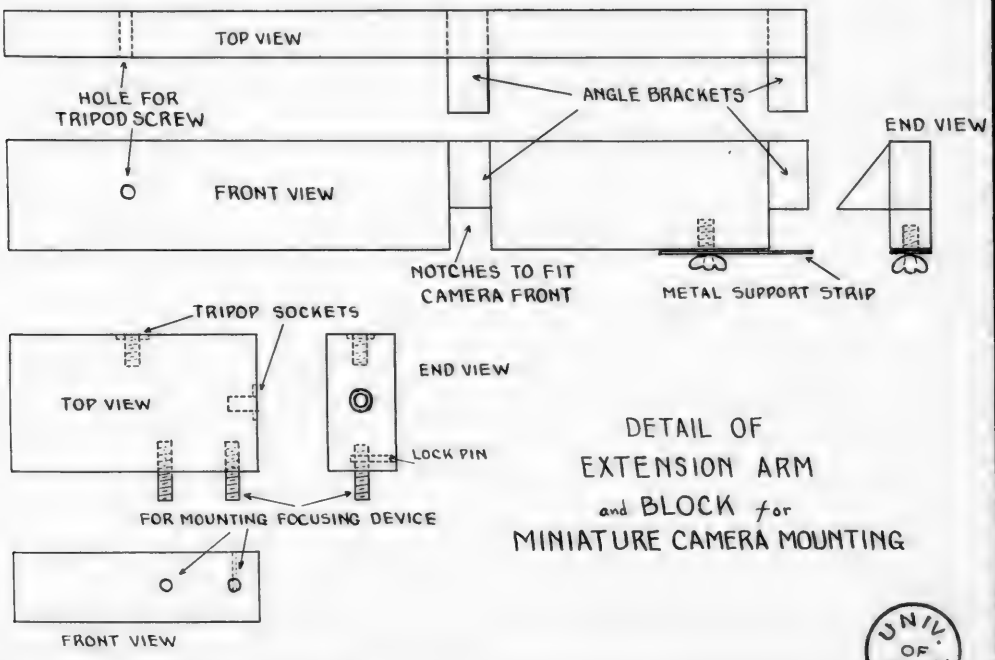

DETAIL OF
EXTENSION ARM
and BLOCK for
MINIATURE CAMERA MOUNTING

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A MODERN PHOTOGRAPHIC DIVISION

STELLA ZIMMER*

WHEN plans were completed for the new College of Medicine at Syracuse University, a space, thirty-one by forty-four feet, on the second floor was allotted to the photographic division. In addition a fire-proof vault, for the storage of films, is reached by a winding stairway from the fourth floor. This vault projects from the roof and corresponds to the elevator shaft on the opposite side of the building. The space has been utilized not only to adequately take care of the present volume of work, but to provide for future development. Suggestions by Mr. Schmidt of Rockefeller Institute, Mr. Ter-Louw and Mr. Fuchs of Eastman Kodak Co. and other members of the Biological Photographic Association have been helpful and many of their ideas have been incorporated in the plans. Large windows in the general photographic room, office and work room, a modern ventilating system in the dark room and photomicrographic room, and an extra telephone jack installed in the work room, make excellent working conditions. Heavy duty wiring, with plentiful floor and wall outlets, provide for any desired illumination and ready means for the use of electrical equipment.

Figure 1 shows a line drawing of the floor plan. Doors from the waiting room lead to the office, general photographic room and photomicrographic room. To the left of the large photographic room is a small dressing room and to the right, a work room. Mazes lead from the work room and photomicrographic room to the dark room.

The office is equipped with desk, typewriter, files and locker. Lantern slides, made for the various departments not located in the College, are filed in a Multiplex Lantern Slide Cabinet. To avoid "tying-up" the general photographic room, a divan, which can be readily made into a cot, is in the office for use in emergencies.

The General Photographic Room, figures 2 and 3, is equipped for the various types of photography other than photomicrography. A chair and examining table combination, with head rest and stirrups, fills the need for most clinical cases. A single unit bedside screen, with reversible black and white curtains, is used for the desired backgrounds. When photographing full

* Received for publication July 5, 1938. College of Medicine, Syracuse University, N. Y.

lengths, or when a support is essential to avoid motion, a curtain is stretched from the floor to a wooden slab on the wall. An Eastman Clinical Camera is for general use, but for photography of children and patients who are unable to cooperate there is a 4 x 5 Speed Graphic with a Kalart Synchronized Range Finder, Synchronizer and Shutter Adapter. A special camera stand designed

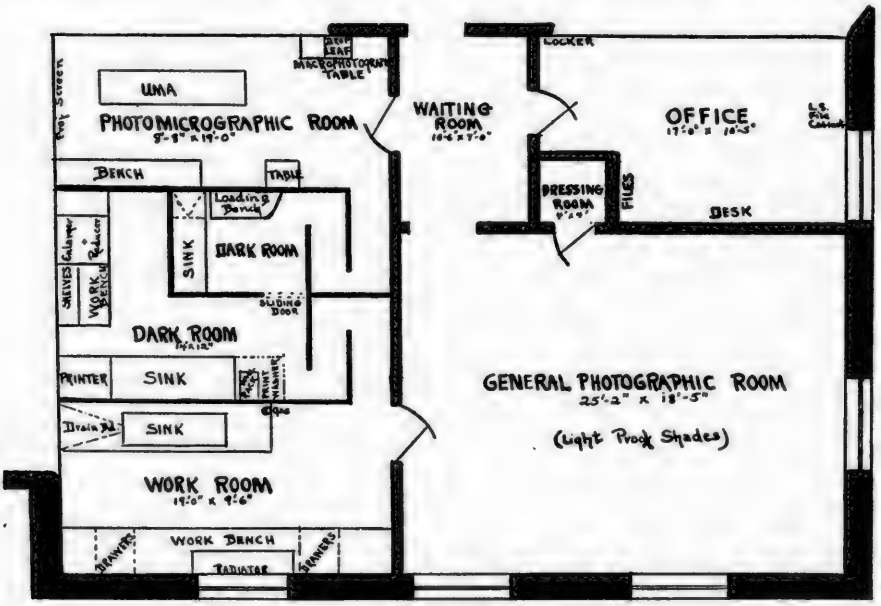

FIGURE 1.

by Folmer-Graflex Corp., for photographing eyes, is used with a Graflex especially fitted with a Tessar Lens f:3.5. An extension racking device which projects from the camera stand allows the photographer to operate at a very close range.

For photographing of gross, fresh or wet specimens, a camera stand designed by Mr. Louis Schmidt and described in THE JOURNAL OF THE BIOLOGICAL PHOTOGRAPHIC ASSOCIATION, Vol. I, No. 2,[1] is used. This apparatus is equipped with an Eastman View Camera with a Cooke Anastigmat Lens—f:6.3—13 inch. The stand may also be used for portraiture, with a Kodak Anastigmat Lens f:4.5—12 inch.

[1] Schmidt, Louis, and Haulenbeek, Joseph B.: A method of photographing gross specimens. *Jour. of Biol. Photo. Assoc.*, 1:76–79, Dec. '32.

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At present copies are made by tacking the material to a copying board or by enclosing it in a large printing frame. An Eastman Illuminator is used for reduction of radiographs.

Two Victor Photoflood Lamps, two Eastman Kodaflectors, a Zenith Spotlight and a single unit 500 watt light give various types of illumination. New apparatus also includes a utility table on caster wheels and a surgical cabinet. The dressing room has a wall table, chair and mirror.

A work bench extends along the east wall of the work room. A stone sink with drain boards on each side is located on the west wall. Metal drawers and cupboards beneath the sink make ideal storage space for chemicals and containers for the mixing of solutions. A ten-gallon tank for the storage of distilled water stands at one end of the sink and a two burner gas plate at the other. A Kodak Dry Mount Press and Tacking Iron, a twenty-inch Trimmer and an Eastman Professional Print Dryer complete the workroom equipment.

Light-proof partitions and a sliding door divide the dark room into two separate units. The larger compartment is for printing and making lantern slides; the smaller for developing. As advocated by Eastman Kodak Co., the sinks have been built of cypress and lined with chemical proof lead. An eighteen inch Penn Photo Wringer is fastened on the printing sink and a grooved rack for ferrotype plates is suspended from the wall above and at the lower end of the sink. An Eastman Professional Printer, the printing sink and a large print washer occupy the east wall of the dark room. A large work bench, on which is placed the Auto Focus Enlarger with Reducing Attachment, has been built along the south wall. Solutions and trays are stored in compartments beneath the sink, making the one long shelf, which extends the full length of the wall, available for printing papers, timers, measuring cylinders and graduates.

The compartment beneath the work bench is divided into two sections. The right section consists of three large drawers and a small cupboard and the left section of a sliding shelf for the trimmer above a compartment, sufficiently large enough to enclose a number of drying racks. The doors are mounted with cheesecloth, giving free circulation of air. An electric fan, installed in the left hand corner, can be used when rapid drying is essential.

The developing room is very similar to the printing room. Shelves for films and film holders and racks for hangers have been built over the loading bench and sink. The compartment beneath the loading bench encloses an Igl Electric Combination Dryer and Heating Element on the left side and an especially designed drawer and compartment for film hangers on the right. Rods

of various lengths readily accommodate to either five by seven or eight by ten hangers, or both. A Wratten Safelight Lamp hooks up with a foot switch. Indirect light boxes and numerous safelight lamps give the illumination and protection needed.

The photomicrographic room, figure 4, equipment consists of a Leitz Photomicrographic Apparatus "UMA" and Macrophotographic Apparatus "MAIVa." Two tables, with drop leaves and caster wheels, which lock to the floor, have been built for the macrophotographic apparatus and balopticon. An extensive work bench supplies facilities for the use of substage lamps and microscopes. Drawers and a large compartment beneath the table are for storage of lenses and microscopes. An illuminating screen for testing slides is hung at the further end of the room. A Spencer Color Slide Delineoscope and two Bausch and Lomb Balopticons, for use in the various lecture rooms, are handled from the department.

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NOTES ON TELEPHOTO MANIPULATION

CHARLES S. APGAR, JR.*

IN a previous article the author described the construction of a cinetelephotographic unit especially assembled for efficient use in the photography of wild life. There are certain factors that should be constantly borne in mind in constructing and using such a unit that will tend to make the results of its use more satisfactory.

In constructing the unit attention should be paid to the peculiar desires of the person who is to use it. This means that the result will be a highly specialized instrument fitted for the use of one particular operator. Just as a gun should properly fit the user, so it is true of this special camera. It is therefore apparent that too much care cannot be spent in getting the unit to exactly fit the user, since the recorded "shots" are very similar to the making of a fine

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score with a gun. Thus, any adjustments that will further the end in view should be welcomed.

It is absolutely necessary with the use of an objective having a magnification of 8½ diameters to enlarge the finder image to approximate that of the objective. Practically all telephotographic equipment sold is supplied with supplemental finders which reduce the field of view in the finder to that covered by the telephoto lens. Since the finder image is greatly reduced from the actual scene, the addition of still further reduction renders an extremely miniature scene, the detail of which is impossible to determine. Another method is to engrave the original finder lens into several sections which correspond to various focal lengths of telephoto equipment that might be used on the camera, or masks can be placed in the finder and thus effect a reduction the same as in the above arrangement. Any of these types of finders are absolutely impossible to use in filming the activities of animals that are some distance from the camera. A magnifying finder is therefore mandatory.

Telephotography without a lens hood is disastrous. The hood should be as long as possible and lined with black velvet, the pile directed outward. This hood should be internally threaded to screw over the outer end of the lens mount; folding hoods are lightly constructed makeshifts and entirely unsatisfactory.

After the unit was assembled it was found that considerable practice was necessary in operating the camera so that accurate "shots" could be made in the field. The camera was used, without film, for about a week, hunting the small animals that were found in a nearby park. Then exposure and coordination tests were made on film. It was found that after acquiring the knack, such things as "follow shots" were quite possible. Though these types of exposures could be made offhand, a camera rest of some sort was used wherever possible. There was usually some sort of support available, such as a stump, but when there was no great weight of extra film carried, a small folding tripod was added to the equipment as a camera rest.

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OSCAR W. RICHARDS*

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OSCAR W. RICHARDS*

EARLY motion picture development received a considerable impetus from biologists interested in the analysis of motion. The early studies of motion were made by various mechanical levers which were not satisfactory and experimenters turned to photography. In 1865 Onimus and Martin took successive photographs of the heart on a single wet collodion plate and this method of phantom photography has recently been revived in medical work. Successive images showing the passage of Venus over the sun were made on a revolving plate by Janssen in 1874. Muybridge in Philadelphia obtained successive pictures with a series of cameras, each of which, in turn, made a photograph of the moving animal.

The real development of the method should be credited to Marey (1830–1904) who turned to photography in the late 70's. His first contribution constituted a solution of the problem of taking pictures at equal intervals of time. A long plate was passed through the camera as the successive pictures were made. Three cameras took pictures of the same animal at the same interval of time, and from these three pictures, three dimensional models were built and exhibited in the Zoötrope. This device had a series of slits through the outside of its cylindrical surface, and in front of each slit was a model of the animal. The instrument was rotated and as one looked through the slits the effect approximated motion pictures. During the early 80's Marey built the camera into the form of a gun. This camera gun was very much like those which have recently appeared on the market for the benefit of the news photographers. Eastman's invention of flexible film in 1889 made possible rapid advances in this field. By 1892 Marey had coupled his film camera to the microscope for making cinephotomicrographs and by 1893 he was using his motion picture projector.

Medical teaching films were apparently first made in Paris by Dr. Doyen in 1898 and by Dr. Chase of Boston in 1906. Considerable public disapproval greeted the films, but they were so valuable that their use has steadily in-

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creased. Hitherto, motion pictures were taken at normal rate and projected at the same rate or else were taken at a rapid rate and projected slowly—slow motion pictures. Pizon, in 1904, reversed this process by taking photographs of the development of an Ascidian colony, spaced at intervals over a long period of time, and then projecting the pictures rapidly when showing them.

After the death of Marey, the work at the *Collège de France* was taken over by François-Frank. Comandon entered the field and published pictures of bacteria about 1909. He interested Pathé in his work, gained his assistance and the combination has led to a number of biological films.

Cinematography, because of its obvious advantages, soon spread to all countries and its history becomes too complex for the scope of this paper.[1]

Kinds of Motion Pictures

The fundamental advantage of the motion picture is to show motion, or to contrast motion with rest. There is no excuse for a film which is nothing more than a series of still pictures. The peculiar advantages of the motion picture come from the opportunity to make the picture from the best viewpoint, and of showing it to a number of people simultaneously. It can bring to an audience what otherwise they might be unable to see and study. The study of phenomena recorded in motion pictures is facilitated because the film may be kept and re-examined as often as is necessary to synthesize in the mind all of the information included in the film. The motion picture is a convenient means for changing time; by its aid we may accelerate or retard time. Frequently it is only possible to analyze motion when time is properly regulated for this purpose. On the other hand, it may be that clock time is not the best measure for biological processes, and that the use of time thus changed may well lead toward an understanding of some of the more complex vital processes (*e.g.* the motion, growth).

Motion pictures may be classed as: entertainment, record, commercial, analytical, and teaching. Films for entertainment depend on the nature of the audience to be entertained. Record films need no comment, they are successful to the extent to which they provide a useful record. The commercial film is also of limited importance, because its success is judged from the sales standpoint and is successful when it brings dollars and cents to its sponsor. Analytical films permit the control of time and are also of great value when a con-

[1] *Cf.* Heard, O. O., Some practical consideration on time lapse motion photomicrographic devices. *Jour. Biol. Photogr. Assoc.*, 1932, 1:4–19; and Richards, O. W., From photochronography and biotachygraphy to cinephotomicrography, *ibid.*, 1933, 2:39–55.

sultation by a number of individuals is desirable. Some of these films are useful teaching aids. Others are not useful unless they are edited for a given type of teaching. Once a film is so edited, it loses a considerable amount of flexibility and may not be as useful for other purposes. Consequently, in making a teaching film it is necessary to plan for a good deal of freedom so that the film may be re-edited to serve the needs of different types of teaching. It is quite obvious that the film considered of best value in college might not be the same film that would be preferred for sixth grade biology, and vice versa.

Little attention need be given to the problems of color, black and white, sound and size, because these answer themselves in practical work. Color films are desirable for anything that is of other color than black and white, but because of the increased cost, black and white films will probably predominate for a considerable period of time. Yet, there is no advantage in making a color film of any object which lacks color. Sound films are of great importance and in some cases sound is essential. Except in a few limited cases, sound has little advantage and it is quite probable that most sound films will not be accepted generally for teaching films at the college level. Films shown in educational institutions, commercial houses, and in the home, will probably be of 16 mm. or 8 mm. size. Whether or not the original negative is to be taken on 35 mm. film depends on the likelihood of its use in the standard motion picture playhouse. If not, then the smaller sizes are frequently entirely successful. Once the negative is available on the larger size it may be reduced as required. The 8 mm. film is becoming increasingly popular and it is premature to make any statement as to which size may find greatest general use. The problems of the direct reversal process or the positive negative process are usually answered by questions of cost and the number of copies that are likely to be required.

Equipment for cinephotomicrography has largely been built by the individuals making the films. Examples of such are the apparatus designed by Canti, the Lewises, Heard, Chambers & Grand, Rogers, Patten & Kramer, Richards, and by Proetz. Commercial firms have not entered this field to any extent. Bell & Howell have an attachment for their motion picture camera which contains the beam-splitter made by the Spencer Lens Co. Bausch & Lomb marketed an outfit consisting of a beam-splitter, motor drive and camera, and recently the Eastman Kodak Co. has produced a timing device to use with their Cinekodak Special. Many of these are rather expensive. There seems to be no great demand for this type of equipment at the present time, though there is a great deal of interest at meetings of scientists and photogra-

phers. It is assuring to note that as soon as interest is shown and questions asked about equipment the commercial houses will manufacture suitable apparatus, and that with a sufficient market efficient equipment could be made to sell for considerably less than current prices.

Standards of Excellence

Standards and criteria for the judging of biological motion pictures have been prepared and published by the Committee in the June 1936 issue of the Journal of the Biological Photographic Association and need not be summarized here.[2]

Present Status

A large number of record and analytical films are being made by scientists the world over. Some of these have limited circulation at scientific meetings, are used in teaching and a few get into circulation for popular use. Travel films are more apt to be shown to the general public. Teaching films are being made by people in different countries of the world and as yet there is no list or means of knowing just how many and how diversified these are.

The International Educational Cinematographic Institute at Rome, a department of the League of Nations, is attempting to correlate the problems and to survey the field. Excellent films have been made in France and are used in connection with teaching. In Germany a great many films are being made and there is an attempt to centralize these so that more effective use may be made of them in teaching. It is difficult to find out exactly what is being done in foreign countries and these statements are based on the comments of visiting biologists.

The largest program of films seems to be the five year program of about fifty biological subjects started in 1934 by G. B. International Limited, in England. A letter from the British Film Institute, London, states that it is not likely that these films will be available for use in the United States for some time. Other active British firms are the London Film Production Limited and Stewart Film Production Limited; both of these are making pictures of biological interest.

In the United States there are a number of producers interested in this type of photography. Probably the work being done by the Erpi-University of Chicago combination, the Harvard group and the U. S. Department of Agricul-

[2] Report of the Committee on Standards for Motion Pictures of Biological Material. *Jour. Biol. Photogr. Assoc.*, 1936, 4:215–220.

ture represents the largest producers. There are several smaller producers. Rather than any one group making all of the films, there is a tendency in this country to farm out the different parts of the production to those qualified to do them, and then to depend on editing for the sequence of the final film. Many individuals are making films and many of the better biological films have so far been made by individuals either as part of their own personal work or as a hobby.

Sources of Films[3]

The manufacturers of equipment and supplies were the first ones to supply a list of available films. Among these, the Bell & Howell, Eastman, and Victor lists are particularly useful. The *Educational Screen* has published and maintains a good list of non-theatrical films. The general need for information of film sources has been met by a number of other groups, chiefly educational institutions. Among these lists are those of the Visual Instructional Service of Iowa State College, the list of the American College of Surgeons, of the American Museum of Natural History, the Y.M.C.A. and many other institutions. The American College of Surgeons is more than a list, for the films so listed are those which meet their own standards of excellence and ethics. Recent additions to the sources of literature are the list of Koon, "Sources of educational film and equipment," the lists of the United States Department of Commerce, Division of Motion Pictures, and the Wilson Catalogue. For a time International Educational Pictures served as a clearing house for orders, so that films could be ordered from their catalogue, and the orders were distributed by them to the firms who had the films.

The most important move at the present time is that of the American Council of Education in connection with the American Film Institute which is preparing a complete catalogue list and descriptions of films available in the United States with particular reference to teaching. Once such a list is gathered, progress will be made toward the evaluation of these pictures which will not only stimulate interest in them, but will facilitate their more general use.

Libraries

Among the larger libraries are the Eastman Kodascope Library, Eastman Medical Films and Teaching Films; Bell & Howell's Filmo Library; and the

[3] Report of the Committee on Motion Pictures, *Jour. Biol. Photogr. Assoc.*, 1935, 3:141–144; 1937, 5:205–207; 1938, 7:92–93. Sources of biological motion picture films, *ibid.*, 1935, 4:194–195.

commercial library of Edited Pictures. Many university extension departments have considerable libraries, notably that at Iowa State College. Some of the museums have circulating libraries, likewise some societies and religious organizations. In fact a list of these would be prohibitive in this paper and those wishing to find local libraries can usually obtain the information from their local photographic supply dealer or from the source lists referred to above.

The high cost of maintaining a library is due largely to replacement of material lost through careless handling of the film. Some very useful libraries have left this field, notably *Ufa*. These same difficulties discourage individuals, in many cases, from loaning or renting their own films. Some individuals and institutions find it more profitable to rent than to buy films when the films are used only occasionally, *e.g.* once a year in each class. Films for libraries must be edited to meet the general demand on the library. Consequently they are often not well adapted to any individual need. When the films are owned by the institution, they may be improved by re-editing to meet their own requirements.

Motion Picture Committee

The Committee on Motion Pictures of the Biological Photographic Association has published three lists of films made by members.[8] In the 1934 list, 55 films are listed; 28 in 1936 and 11 in 1937. This undoubtedly is not complete, but it does include all of the films reported to the Secretary of the Association and to the Committee. We urge that members having motion picture films report the titles to us so that we can report what our membership is doing. This is important even when the member makes a film on a definite contract basis for somebody else and does not have the privilege of releasing the film. In that case, those interested can get in touch with the owner of the film should they wish to see or use it.

In the 1934 report a survey showed that 21 per cent of the members of the Association had motion picture films, 37 per cent had no motion picture film and were not interested, and 18 per cent of the membership had no films, but were making definite preparations for entering this field in the following year. The rest of the members failed to report, were not interested or did not use motion picture film. The first scientific use of 8 mm. film was reported in 1936.

Requests for information on motion picture films are addressed to our Society and many of them are answered by the Chairman of the Committee. Requests have included films for biology, anatomy, hygiene, both mental and

physical, zoology, x-rays, teaching and of general interest. Institutions which have requested to be kept informed of the work done by members of the Biological Photographic Association are the International Educational Cinematographic Institute at Rome, the American Cinema League, Chicago Camera League, Erpi and the United States Office of Education. The usefulness of the Committee will depend on the extent to which the members report their problems, needs, and films that may be available. It is probably unwise that we attempt to operate a film library at the present time or to serve as more than a clearing house of information, although the time will come when our Association should lead in the valuation of biological films and in the means for making them generally available, not only to our own Association, not only to scientific groups, but also, insofar as the films are appropriate, to the general public.

Present Problems

Some notion of the possible demand for motion pictures may be gauged from the fact that at the end of 1936 the American Council of Education reported for the 48 states the following numbers of motion picture projectors in elementary and secondary schools: 35 mm. silent, 3,230; 35 mm. sound, 335; 16 mm. silent, 6,074; 16 mm. sound, 458. By now there are at least 15 per cent more projectors in this section of our school system.

Indicative of the present interest in this field is the survey being made for the American Society of Bacteriologists by Prof. J. M. Birkeland and the founding of the Department of Biophotography at Rutgers University. Dr. Earle B. Perkins heads the latter department. The survey of the former will endeavor to determine the demand, experience, what is being done, availability of films and what is wanted by the members of the Society.

One rich source of biological motion picture material would be to find a means of tapping the Stock Libraries. For instance, among some of the African films which have been shown in the local motion picture houses are a number of shots of animals which would be useful in teaching as well as for entertainment. The owners of these films are quite willing to sell the material, but their prices are often very high—$1.00 per foot. The price is due mainly to the time consumed in finding the particular reel among the hundreds of thousands in storage. However, if the users could combine so that a number of prints could be ordered at the same time, the cost per print would be materially reduced and placed within the means of many users of biological motion pictures.

One real difficulty confronting all users of biological motion pictures at the

present time and one which may have prevented some from entering into this field is the fact that one cannot tell beforehand whether or not the material ordered will be what is desired. Catalogue descriptions are frequently inadequate for sometimes the film contains little about what the catalogue lists and much that it does not list. Sometimes one finds the same film in different catalogues under different titles. There certainly is no excuse for using more than one title for the same film. The problem of valuation is one that is exceedingly difficult. The criteria of excellence vary according to the different needs. As soon as complete lists become available, some group interested in motion pictures and biology, but not limited to any single type of institution, should sponsor an evaluating committee for the review and evaluation of these films, in terms of the criteria of the several different types of films and their uses. Films could then be ordered with some assurance of obtaining what is required. This is a problem which should be brought before our Association from time to time because we are in a unique position to aid in starting this when the time is ripe.

A film clearing house would do more than anything else to improve motion pictures and get them into more general use, not only those of biological science but of other sciences. At the present time it is a little unlikely that any commercial house can do this because of the difficulties of obtaining all types of film, the cost of running the exchange, the cost of special editing and the replacement cost of film damaged through careless use. To do this successfully, such a clearing house must have some form of subsidy beyond what it could earn, at least during the first years. If the costs are to be met out of the rental fees, the fees would be so high as to lessen the opportunity and prevent many interested groups from using films. Such a clearing house would solve the problem of how to make available the films of individuals. Some of us have films that we would be willing to make available provided they could be turned over to a reliable group and that we would be free of the problem of editing, damage and the necessary correspondence and trouble involved. Quite a few scientific films could probably be obtained free, or at no more cost than an occasional print for the owner of the film. Such a clearing house might be set up by an educational institution, or better, this would be a real opportunity for the United States government to use some of its money for the general betterment of mankind.

Relatively few biological films, outside of travel type film, have gone before the general public, and the general public as a whole knows little of the scope of our work. It is time that more education be sponsored in this country and

our Association might well consider the possibilities and problems involved. This is a field in which Great Britain is leading at the present time. An article recently published in *Nature* states that "A Scientific Film Group of the Association of Scientific Workers was formed about a year ago to encourage the growth of good instructional and documentary films, dealing both with 'pure science,' and, perhaps even more important, with science as a social force. The group has accordingly given shows of approved scientific films in London, at Cambridge, Oxford and elsewhere, which have demonstrated that there is considerable public for such films. To enable this work to continue on a more ample scale in London, however, while complying with the L. C. C. regulations, it has now become necessary to consider forming a Scientific Film Society. Such a society would be open to all interested persons, whether members of the Association of Scientific Workers or not, and would give at least four film shows a year in local cinemas on Sunday afternoons. It would not be possible to sell tickets for such shows to the general public, but a limited number of guest tickets would be available to members. Any profits arising from the Society's work would be devoted exclusively to non-commercial purposes such as the making and adapting of scientific films" (1938, 141:1005). This is an excellent example which should receive consideration in this country.

There is a real demand for pictures of biological material properly done and this is a challenge to the members of the Biological Photographic Association to make some of these films and to profit from this demand. A great deal of personal satisfaction comes from the making of a good motion picture film and if properly handled it should return the financial compensation due the maker. If individuals are to do this work, an inexpensive printer is needed and as soon as this is demanded, it is quite certain that some firm will turn out the necessary equipment. Cinephotographic equipment is also available and better and less expensive types of equipment will be furnished as soon as you ask for them. The need for motion pictures is fully as great in the other branches of science as in biological science, so that those members of the Association with leaning toward other fields have opportunities before them. Greater and more rapid progress would come from cooperation, either among individual members of the Association or between members of the Association and other groups equipped and interested in doing this work. Members of our Association not only have the opportunity for leading in this field, but have an obligation to do so.

PHOTOGRAPHIC TECHNIC, NEW PROCESSES, AND EQUIPMENT

Random Notes on the Production of Silent Medical Motion Pictures

F. R. HARDING*

PRE- and postoperative motion pictures showing orthopedic malfunction and its correction are an important part of the record system in many hospitals. These include gait motion pictures of preoperative patients and "follow up" films postoperatively. These films are of value for teaching purposes, and are also of great value as an individual record of the patient. Other uses include motion pictures of specialized operative procedure, slow motion studies of unusual gaits, and unusual or rare medical and surgical cases. All this material could well be employed in teaching nurses and medical students.

It has been noticed that long teaching films (400 ft. and over) frequently do not produce the desired result because the student becomes inattentive and restless. Employment of short silent films from 15 to 100 feet in length, to bring out points in the lecture, have been very successful. This may be done by either one of two methods. The regular lecture may cease while the short film is run, with a comment about the film by the lecturer, or a number of very short "points" may be spliced together and separated by about 6 inches of plain film. Upon signal from the instructor, the projector is started and the "point" run off, the instructor continuing the lecture as usual. As soon as the next section of plain film shows, the projector is stopped. In this way there is no loss of continuity in the lecture, caused by cessation of the lecture while the film is being shown. The projector employed must produce a brilliant image so that there may be enough weak overhead light in the room to allow the students to take notes.

Complaints are sometimes made by students that surgical procedures are made to appear much too simple in the motion picture, and unfortunately this is quite true as, of course, many of the non-essentials are not photographed. This gives the impression that a major operation is very simple to perform.

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The operation may have lasted for two hours, for example, but the complete motion picture runs through the projector in about twenty minutes. For example, this question of apparent simplicity was raised by a fracture class, in which the reduction and aftercare of fractures of the long bones were taught partly by motion pictures. The students felt that the motion picture made the reduction appear too easy and simple. Making use of the previously mentioned "point" system of projection, in which a motion picture of the particular fracture being lectured about is projected on the screen, would be of some aid in overcoming this difficulty.

There are some pitfalls which must be avoided when gait films are made. Films of this type should be made in moderately slow motion, usually thirty-two frames per second. This will slow down the foot action so that it may be studied with ease, and at the same time it will not require a great increase in the amount of light needed. The correct exposure will require one stop larger than is correct with normal silent speed, which is 16 frames per second. One severe drawback in the production of gait films is the great amount of space required. If this space is not available (15 x 45 feet is about the minimum space for adults) it is better not to make the attempt until space is available. The usual routine calls for the patient to walk toward and away from the camera and then to walk from side to side, across the field. The latter, called the lateral walk, *must* be made in moderate slow motion, otherwise, the foot and leg action will be a confused blur. It might be possible to arrange a smoothly traveling platform for the camera so that the patient would be of uniform size throughout the front and back walks. This method has been tried on children by the writer. It had to be discarded because the proper distance could not be maintained between camera and patient. The children increased their gait speed so that they might catch up with the tripod truck.

Orthopedic surgeons at times require films of patients walking up and down stairs. This presents a problem in lighting and camera angles. Most stairways cannot be utilized for lateral views of stair walking, and it is sometimes difficult to block traffic on stairs for sufficient time to do any work. The remedy is to have a short flight of perhaps four steps built. The stairs should be constructed with substantial hand rails on each side, and should consist of four ascending steps terminating at a small platform, and four descending steps on the opposite side. With a stairway so constructed, a lateral film may be made of the patient ascending and descending, with a minimum amount of time consumed and with adequate light. The stairs should be sufficiently narrow

to pass through all doorways in the photographic department. Some storage space outside the department can usually be found in which to keep them when not needed. Casters may be placed on the bottom for transportation and either removed or locked when the stairs are used.

Films of medical and surgical subjects are frequently made and put in storage with the idea of incorporating them in a teaching film at a later date. This sometimes results in an accumulation of short films that never seem to be called for. A list of the diagnoses and a note to the chief of the particular department involved will sometimes result in the assembly of a valuable teaching film. Most chiefs of services appreciate reminders of this kind, as it is impossible for them to keep details of this sort in mind.

Motion pictures made in the wards are sometimes of poor quality. This is caused by confused backgrounds which are often impossible to eliminate; and by inadequate lighting. Many ward motion pictures are made with a combination of daylight and artificial light. This leads to poor films because of the difficulty in balancing the two kinds of light. In general it may be said that most black and white motion picture film is 25 to 100 per cent faster with daylight than with artificial light, with the result that it takes a great deal of experience to successfully mix them. Color motion pictures should never be made with mixed light. In view of these facts, it would seem that if the best possible film is to be made, that the patient should be transported to the photographic department, where there are adequate backgrounds and plenty of artificial lights. It frequently happens that the motion picture must be made in the ward due to the condition of the patient or some other cause. Two No. 2 photo floods in suitable reflectors will produce a good balanced light, or one 1000 watt lamp placed so that it flat lights the patient will work fairly well if there is not a lot of space to cover with the light. The latter light usually works well, because most ward films are made in the form of semi-close-up or close-up views.

Many medical motion pictures could be improved by judicious back and side lighting. This may be easily done, and if not carried to extremes, produces a much more pleasing film than the conventional flat lighting. If cross lighting is carried to extremes, it will become so noticeable that it will detract from the action being filmed.

No medical film, however short, should be filmed without a rehearsal, except of course, operative procedure. All films of any length, especially teaching films, should be made from a written scenario and a working schedule. Films made in this manner are more easily edited and have a much better

continuity than those made in a haphazard manner. A conference between the photographer and the persons concerned with the film is most essential. The scenario can be written at this time or submitted afterward.

Unless a proof printing press or something similar is available for making titles, the material should be sent to a professional title maker. There is nothing that will ruin a well made film quicker than poorly made titles. If the film is good enough for use as a teaching film, it should have well made titles with plain backgrounds. Employment of titles with fancy backgrounds seems out of place in a medical film. Movable white celluloid letters inserted in a slotted board, or white paper letters pasted on black cardboard produce titles with a most unprofessional appearance. A rough guide to the total footage of an individual title is, to start the camera, read the title through slowly, twice, then stop the camera and proceed with the next title.

An exposure meter and range finder, or tape-measure, are essential if consistently good films are to be produced. Even if the lighting is fixed and the distance is known, it is an excellent idea to frequently check the exposure by meter. Remember that lamps discolor with use, and emit less light. This is most marked when photo-flood lamps are employed, because this type of lamp discolors very rapidly. If checking of exposure and distance is not habitually done, sooner or later trouble will be encountered. This appears to happen invariably on an important film that cannot be duplicated.

Suggestions for Avoiding Unwanted Small Jobs

When a group of biological photographers get together, invariably someone brings up the subject of requests for developing and printing rolls of film for members of the staff. Many of our members can find no way of refusing to do this type of work.

There are few, if any, institutional photographic departments which are equipped to handle roll film development and the making of amateur sized prints. It is sometimes almost impossible to avoid accepting some of this type of work. It depends very largely on the position of the person who brings the work in as to whether or not it can be refused. The average staff member or superintendent usually has sufficient intelligence to know that the photographer does not have time to handle such small and relatively trivial jobs. They do not always think of this unless the photographer mentions the fact that he is not equipped to handle that type of work.

An explanation can be made that the roll must be developed by hand instead

of in deep tanks which would be done in commercial finishing plants, and that printing of small negatives on a large printing machine requires considerably more time—as they are not easy to handle—than would be the case with larger negatives. Also, a good many printing machines are not equipped to make white margins on prints, which means that a separate black paper mat must be cut for each size negative in order to make these margins.

Whenever the status of the person making the request is such that a polite but firm refusal can be made without giving offense, it should be done. Another method of getting rid of this type of work is to double price everything that is done. Make a charge twice as great as the finishers in the locality charge. When the inevitable complaint about the charge is made, tell them that it costs a great deal more for you to produce those prints than it does a plant which is equipped to handle them.

Another method which can be used with people you do not wish to offend, and who are expecting to pay for the work, is to take them to the "corner drug store" and let the drug store do the finishing. This has been tried by some individuals known to the writer and seems to work very well.

The proper time to protest amateur roll work is the first time that an individual brings this type of work to the department. If one job is done and the customer is satisfied and a protest is made on the second trip, it will not bear as much weight as though the protest had been made on the initial trip.

News from Bell & Howell

The Bell & Howell Company have announced a new 16 mm. projector, entirely gear driven, called the "Filmaster." This new machine is moderately priced and contains many features hitherto found only in projectors selling at a higher price level. It may be used with either 300, 400, 500, or 750 watt line voltage lamps which would give almost any degree of screen illumination desired. A drop-front compartmented carrying case is regularly furnished.

This company also announces price reductions all along the line for both cameras and projector models for both 8 and 16 mm. machines. A few models have been discontinued, and many of the machines have been given names which supersede the former model numbers.

Photrix Electronic Timer

The Intercontinental Marketing Corporation of New York has recently introduced the Photrix Electronic Timer for controlling exposures in contact

printing or enlarging. It is made in several models of different timing capacities. It will produce split second exposures down to $\frac{1}{10}$ of a second with accuracy of timing. It contains no clock works, does not require resetting after each exposure, and contains features for remote control by a foot pedal or by the platen switch of commercial contact printers. The Photrix Timer has no moving parts, it is not subject to wear or mechanical defects, its precision is permanent, and no readjusting is necessary at any time.

New Lamps for Type B Kodachrome

The Incandescent Lamp Department of the General Electric Company in collaboration with the Research Laboratory of the Eastman Kodak Company have designed the following group of lamps especially for use with Kodachrome Type B color film.

Watts	*Bulb*	*Volts*	*Base*	*Initial Color Temp.*	*Approx. Life*	*List Price*
5000	G–64	110–115–120	Mog. Bipost	3250	150	$25.00
2000	G–48	110–115–120	Mog. Bipost	3250	60	11.00
1500	PS–52	110–115–120	Mog. Screw	3250	100	6.00
1000	PS–52	110–115–120	Mog. Screw	3250	75	4.25
1000	G–40	110–115–120	Mog. Screw	3250	35	6.75
500	A–25	110–115–120	Med. Screw	3250	20	.70

It will be noted that these lamps have an initial color temperature of 3250° K., although intended for a film balanced to 3200° K. The first five lamps in the line have a color temperature depreciation of approximately one degree per hour. The 500 watt lamp has a greater rate of depreciation than this because of its relatively small bulb. Thus these lamps will have a color temperature of above the required value during part of their life and below during the remainder of life. Furthermore, a photographic setting will often be lighted with several lamps of a variety of ages. Therefore, the average color temperature will be fairly close to 3200° K.

The first five lamps listed in the above table are intended primarily for commercial and portrait photographers, while the 500 watt lamp meets the requirements of amateurs and others equipped with reflectors using medium-screw sockets. The lamps will be known and marked as "3200° K." and orders should be so marked.

Users of these lamps should be cautioned to make every provision to have

the lamps operate at labeled volts. The importance of this is evident as five volts departure will change the color temperature 50° K.

New Eastman Kodak Products

The Eastman Kodak Company announces two new processing room aids, the Eastko Rubber Squeegee and the Kodak Tray Thermometer. The Eastko Rubber Squeegee has a 10-inch blade of soft rubber which is vulcanized into a hard rubber handle. It is designed for a long life of hard service, and should be an addition to any processing room. The Kodak Tray Thermometer is purposely made small and has a lip to fit over the tray's rim and gives a constant check on developer temperature. It has a short scale—from 60° F. to 80° F.—plainly marked on its stainless steel support.

A New Album

We have a new volume in our library of Albums. This is a bound book of pictures made by Wilbour Chace Lown, photographer at the Massachusetts General Hospital, Boston. The first section consists of photography of patients and lesions; the last section of gross specimens and equipment. There are several blank pages at the end of each section. Information about the technic used is given with individual pictures or with groups of pictures. Mr. Lown invites photographers who see his book to use these blank pages for adding samples of their own work and comments. This is a novel idea and if carried out would make the book even more interesting. Quite without additions, however, it is well worth the study of the medical photographer, and of any student of scientific photography. The Association is indebted to Mr. Lown for the time and care which manifestly went into the making of this Album. We know it will fulfil its aim of being useful to other workers.

Besides Mr. Lown's, the following Albums are available to members, for the cost of transportation one way: Photographic Methods of the Rockefeller Institute for Medical Research, by Louis Schmidt and Joseph Haulenbeek; Photography of Plant Research, Rockefeller Institute, Princeton, N. J., by Julian Carlile; Photography of the Anterior Eye, by Adolph Marfaing, Institute of Ophthalmology, Columbia University, New York. Technical information accompanies the photographs in each of these. To obtain the Albums, write to Miss Florence Melvin, Department of Research and Surgery, Kinsman Hall, Ohio State University, Columbus, Ohio; or to the Secretary.

CHATS WITH THE EDITOR

II. THE PHOTOGRAPHER TALKS TO THE AUTHOR

THE Medical Photographer tucked away his pencil and shoved the result of his effort at the Medical Editor.

"There, print that in your paper!"

He settled back in his chair and tossed off a bumper of Hypo as the Editor read:

The Medical Author, as you say, is usually only an occasional author. His mental machinery runs in other channels; his reputation rests neither upon his style nor yet upon his spelling. He has an idea and a burning urge to divulge it—or maybe some desperate Secretary has written him that if he wants to keep his standing with the Society he'll jolly well present a paper at the Annual Meeting, come Michaelmas.

In any case his eye is strictly on the main issue; he knows that if he says things consecutively to the Stenographer, papers will appear on his desk in the evening which the good woman will somehow have made into a manuscript.

Comes Michaelmas! Bag packed, hat on head and MS. in pocket, he flings out of the house on his way to the meeting. Just as the door slams, he remembers he has forgotten something. He rushes back, gets the Photographer on the phone and asks him to make a few illustrations for the Magnum Opus. It ought to stand up better with, say thirty or forty pictures.

After the meeting, when the fog has cleared from his brain and the tobacco-smoke from his hair, take him off to a quiet spot, and in words of four syllables tell him these simple things for me:

1. Almost anything on earth can be recorded photographically—but not with a box camera and a candle—and not by tomorrow morning.

2. The Photographer's one desire is to make the finest illustration of his subject that can be made. This requires time and thought and the proper facilities. If he likes to do the work in his own shop, let him.

3. It took some photographer literally *hours* to take that lifelike picture of a striped shirt that catches the eye in yon magazine. The same lighting, the same careful composition, the same knowledge of filters and negatives and printing technique will have to go into that portrait of the teratoma if it is to compete with the shirt in print quality.

4. Cameras lie. Sometimes on purpose, sometimes willy-nilly. Your photographer can produce a number of effects at will. An extreme example is that produced with materials sensitive only to infra-red rays, in which skies come out dark and leaves pale. If the artist has a clear understanding of the purpose of the illustration, he can use materials best suited to it.

5. Knowledge of the medium in which the illustration is to be produced and the size of the page on which it will appear, help the photographer to select his materials and to compose his subject most suitably.

6. Wet specimens should not be allowed to dry, nor be put into solutions which may discolor or distort them before they are photographed. Many such specimens are best photographed under water.

7. If both lantern slides and illustrations are required, it is usually best to make separate negatives, as the degree of contrast in the former is purposely made greater than in the latter. Let the photographer be the judge.

8. Microscopic sections, for best results, should be cut thin, mounted smoothly and stained evenly. If the staining is in two colors, the photographer can accentuate or subdue one of them, sometimes a useful procedure.

9. Many a fine print has been ruined by clipping the legend to it. The marks left by the clip show in the reproduction. Writing on the back with a pencil usually shows through; ink is better. Don't press. Mail the prints flat, with plenty of stiff cardboard fore and aft. *"Do Not Bend"* on the flexible envelope is twin brother to *"Wet Paint"* on the fence. It practically insures a good crack down the middle.

10. This is an age of superb photography and photographic reproduction. Magazine editors who buy their photographs have unlimited stocks of first-rate prints at their disposal. Medical editors, when they receive articles with inferior illustrations cannot send out and buy better ones. Neither can they cheapen their journals by printing the bad pictures.

Result: Pictures deleted, or paper rejected.

Moral: One picture in print is worth ten on the shelf.

ARTHUR W. PROETZ, M.D.
Editor of the *Annals of Otology, Rhinology, and Laryngology.*

WHY ATTEND THE CONVENTION?

In all probability, nothing will stimulate and contribute more to the success of the biological photographer than to meet in convention with other individuals in the field.

It is evident that an abundant knowledge of this specialized field of photography can only be attained by intensive study, thought and observation, both in and out of the laboratory. Agreed, this is a field where the hurdles are high and the pitfalls many, yet they are not insurmountable.

At the annual convention of the Biological Photographic Association the biological photographer has the opportunity of meeting leaders in the specialized fields of this science. All types of technical problems are presented and discussed both formally and informally. In brief, the program of the annual convention seeks to place before the photographer a vast field in which to roam and experiment.

Further—there is a "point" in holding salons of biological photography, namely, to provide the photographer with a tangible means of appraising his work and to demonstrate that it is not good policy to rely alone on one's own judgment. Thus, a series of prints, entered in the exhibit, represents a visual demonstration of the ability of the photographer. All of the entries accepted for the convention exhibit comprise the travelling salon, which will be shown in various cities throughout the United States.

The most direct way to develop enthusiasm is to stimulate interest. Interest, in turn, will create curiosity. An intensely curious photographer without doubt will improve the functional service to his institution. On the other hand, the institution, which realizes and appreciates the role that the photographer is playing in the field of the biological sciences, should encourage its photographer in this quest for improvement and progress by sending him or her to this annual convention.

This year the association will enjoy the privilege of meeting in the Mellon Institute at Pittsburgh, Pa., under the sponsorship of the Pittsburgh Chapter. Miss Anne Shiras, secretary of the association, is an active member of the chapter. And since Miss Shiras is a most efficient and tireless organizer and worker, and since the Pittsburgh Chapter is composed of very active and progressive members, the association is assured of a convention which no member can afford to miss.

CONVENTION AND SALON
SEPTEMBER 1939

The Ninth Annual Convention and Salon

THE ninth convention of the Biological Photographic Association will be held in the Mellon Institute for Industrial Research, Pittsburgh, Pa., September 14th to 16th, inclusive. The Institute is a fitting place for the meetings, scientific in spirit and inspirational in every technical detail. Few visitors will wish to leave without making a tour of it, so the building itself will form part of the program.

A warm welcome awaits you from the Pittsburgh Chapter, which is in a vigorous state of health and looks forward to meeting you. There will be much to talk about, for in our work many things can happen in a year. When you consider that there are over 400 biological societies in the United States—to say nothing of the far greater number of teaching and scientific institutions—you will have some idea of the amount and range of illustrative matter required by them. Yet there is only one Association, here or elsewhere, as far as we know which is attempting to correlate this great field of photographic technic. It is a tremendous undertaking, but well worth doing. By joining in the activities of the B.P.A. you are forwarding this work and yourself at the same time.

Preliminary information about the program, hotel facilities, and other details will be found in Association News. Most of the subject matter presented will be of general interest to the scientific photographer, while one or two will deal with advanced technics still in the experimental stage. All papers will be brief. Ample time will be allowed for discussion. In particular, the sessions dealing with the year's advances in photography, new apparatus, improved equipment, will be conducted informally, so that members may ask for information concerning their particular problems. If you come with questions prepared there will be experienced craftsmen and technical experts to discuss them with you. In this way you will obtain not only general but specific help which may save you much experimenting. Discussion will be encouraged in the formal sessions and in informal gatherings. The scheduled meetings will begin on time and end on time (by request)!

We will endeavor to have the Salon more than ever a part of the program, and will attempt to round it out in various biological fields. As all papers are to be brief, we will ask speakers to use the print exhibit as an accessory to their talk by hanging illustrative material. Thus, the prints can be discussed in detail with members particularly interested. We are happy to announce that the Royal Photographic Society of Great Britain will participate in the Salon. We anticipate some fine work in the British section which should stimulate us to put forth greater effort to make our own section bigger and better than ever. Do not postpone the preparation of your entries until after vacation. Remember all prints must be in by September 8th and you may be rushed at the last minute.

The specifications for the 1939 Salon are as follows:

1939 Salon

All entries must be in the hands of the Salon Committee by September 8, 1939. Please send all material to Miss Anne Shiras, University Office, Magee Hospital, Pittsburgh, Pa. No entries will be accepted after the closing date. Any package that must go through the customs should be plainly labeled: "Photographs for Exhibition—Not for Sale—No Commercial Value—May be opened for postal or customs inspection." An acknowledgment of the arrival of each package will be made by mail.

Prints. All prints must be mounted on light colored stock measuring 16 x 20 or 12 x 16 inches. When a series of prints illustrating one subject is shown, as many prints as convenient should be placed on one mount. All pictures should be precisely captioned. Short descriptions of technic and lighting diagrams should be given wherever a particular problem is being illustrated. The name and address of the exhibitor must appear on the back of each mount; it should also appear in a suitable manner on the face of the mount.

Transparencies. Lantern slides 3¼ x 4 or 2 x 2. Either size is eligible but they must be mounted ready for projection. No film strips will be accepted. Each plate must carry the name of the exhibitor as well as a marker indicating the correct position for placing in the projector. All the accepted entries will be shown at a special evening projection session.

The Salon Committee reserves the right to reproduce any of the exhibit material in our Journal and to give permission for the publication elsewhere of selections from the Salon. Reasonable care will be taken of all entries submitted, but the Committee will not be responsible for damage or loss.

On the back of each print exhibited a suitable label will be placed indicating that it was accepted by the jury.

The prints selected and hung will constitute the Annual Traveling Salon, which will be exhibited throughout the United States. With the exception of transparencies and prints in color, all of this material will be assumed to be the property of the Association for one year after which time it will be returned to the exhibitor on request.

The Committee would appreciate the exhibitor's sanction to apply the same conditions to color prints and transparencies, but will not insist upon it.

Hotel Headquarters

The Webster Hall Hotel is directly across the street from the Mellon Institute, in Pittsburgh's residential district. It will be headquarters, and will provide a lounge for the members to meet in during the three days of the Convention. Its rates are:

Single room, with running water	$2.00
Single room, with bath	$2.50, $3.00 and up
Double room (twin beds), with running water	$3.50
Double room (twin beds), with bath	$4.00, $5.00 and up

There are only a limited number of the lower-priced rooms with baths, such as the single rooms for $2.50 and the doubles for $4.00. Reservations for these should be made as soon as possible.

Cars may be parked at a nearby garage for 50¢ a night, with self-service; 75¢ with delivery.

Incidentally, do you like to swim? The Webster Hall Hotel has a fine pool, open from 2 P.M. to 10 P.M., free to guests. Suits may be rented.

The Schenley, a slightly higher-priced hotel, is one block away, with single rooms and baths, $3.50 and up; double rooms with baths, $5.00 and up.

Welcome to Pittsburgh, September, 1939.

CURRENT PHOTOGRAPHIC ABSTRACTS

K1

A Further Advance in Color Photography. K. Hansen. *Deutscher Drucker,* **43:** 20–22, October, 1936. The monopak type of film is hailed as a practical solution of the color photography problems. As long as a color transparency is available, a paper print is unnecessary. Such transparencies can be readily projected in any reproduction apparatus. A. M.

163–G

Between Ourselves: Warning! *Miniature Camera Mag.,* **2:** 35, December, 1937. Users of Champlin 15 developer are warned not to use this formula at 73° F. with Perutz, Pergrano, or Panatomic films. In several cases, the emulsion oozed off the cellulose base like molasses. Super X was found to have suffered badly from reticulation when developed in this formula at 73° F. T. M. L.

0724

Collotype or Photogelatin Printing—What of Its Future? F. O. Sullivan. *Nat. Lithographer,* **45:** 16–17, February, 1938. The collotype process is briefly outlined. A number of new plants have been started and there appears to be a future for offset collotype which is now being printed at 2000 to 3000 impressions per hour. A. M.

K094–K097

Color Photomicrography. J. Weber. *Leica Photography,* **6:** 6, 16, December, 1937. Work is described briefly on specimens of the central and peripheral nervous systems, using stains made with platinum and gold chloride and silver nitrate impregnations of tissues. The specimens are cut from 5 u to 40 u in thickness. The camera lens is replaced by a Micro-Ibso attachment, which is equipped with its own eyepiece for focusing. An aplanatic-achromatic condenser (1.30 to 1.40 numerical aperture) is preferred. Uniform lighting is secured with a device which consists of a curved flask, fitted into a box 7 by 6 inches, containing a Photoflood lamp. When the flask is filled with water, it serves as a cooling arrangement for the light as well as a means of concentrating the radiation on the microscope mirror. Details are given on exposure for various subjects. G. E. M.

K01

Color Harmony for the Photographer. H. Weller, Jr. *Camera Craft,* **45:** 55–6, 58, 60–2, February, 1938. The principles of color harmony are explained and a number of definitions are given. The author discusses briefly the difference between primary and complementary colors in light and pigments, between additive and subtractive color combina-

tions, and between the three dimensions of color. Definitions are given for: triads, warm and cool colors, keyed colors, neutralized colors, color contrasts, the psychology of color, and the various color harmonies, i.e., analogous, monochromatic, complementary, and triadic harmonies. G. T. E.

094

A Very Simple Method of Microphotography. R. Teunissen. *Focus,* **24:** 728–29, No. 26, 1937. Photomicrographs are made by placing the photographic film in a small frame which rests directly on the upper end of the microscope tube from which the ocular has been removed. C. E. I.

097–X097–056

Photography in Medicine. J. Eggert. *Veroffentl. wiss. Zentral-Labs. Phot. Abt., Agfa,* **5:** 271–82, 1937. A survey is presented of representative applications of photography in the service of medicine. Principles rather than details are explained. Among the cases mentioned are photography of the operating procedure, photography of the interior of the stomach, orthochromatic and infrared records of skin conditions, special types of radiographic examinations, and x-ray motion pictures. An accompanying bibliography refers to the original researches. H. E. S.

097

Photographic Illustration of Medical Subjects. R. V. Dent. *Phot. J.,* **78:** 197–208, April, 1938. In a lecture given before the Royal Photographic Society, February, 1938, the author described the equipment and methods used in the Henry Lister Institute of Medical Research, Shanghai, China. K. G.

314

Seeing the Unseen. R. M. Horn. *Mech. Engineering,* **60:** 199–201, March, 1938. A camera is briefly described and illustrated for taking 35-mm. pictures of rapidly moving objects. The camera has no shutter mechanism but depends solely on intermittent light for shutter action as well as for illumination of the subject. A commutator, placed on the main drive shaft of the camera, operates the control circuit of a stroboscope, causing one flash of light to occur for each standard motion-picture frame traveled by the film. Camera speeds can be controlled so that a few hundred or as high as 6,000 exposures can be obtained per second with such accuracy that precise measurements of acceleration and velocity can be made on the film. A. L. B.

057

An Infinitely Variable Background. R. V. Dent. *Brit. J. Phot.,* **84:** 709–10, Nov. 5, 1937. An illuminating device which allows small objects (from $\frac{1}{10}$th in. up to 7 in. in size) to be photographed against a background of any desired tone is described. The object is set on a plate glass support which encloses a background box, set horizontally on the base of a vertical camera. The rectangular background box serves for the illumination of 14 by 17-inch plain sheets of card, which may be of various tones, by means of miniature lamps, controlled by a rheostat, on each side. The subject is placed on the glass top and

illuminated externally, and black paper masks are set so as just to clear the field of the lens of the camera. By varying the intensity of illumination within the background box, combined, if necessary, with the use of different background cards, a suitable background tone is obtained before the exposure is made. T. L. J. B.

094–056

Ultraviolet Light and Photomicrography: Studies of Animal Skin. E. R. Theis and E. J. Serfass. *J. Amer. Leather Chemists' Assoc.*, **33**: 67–79, February, 1938. The use of the near ultraviolet (365 mμ) for the study of cross sections in animal skin, including its conversion into leather, is advocated. Eleven photomicrographs are reproduced. The ultraviolet can be used as in ordinary photomicrography, for increased resolution and increased contrast, or it can be used to induce fluorescence. In the latter case, the use of fluorescent stains is very advantageous. One stain plus fluorescence exhibits as much differential detail as would be shown by a number of stains or even several sections. A list of several stains is given. R. P. L.

0943

The Principles of Fluorescence Microscopy. J. E. Barnard and F. V. Welch. *J. Roy. Microscop. Soc.*, **57**: 256–59, December, 1937. A description of the author's apparatus for photomicrography by fluorescent light is given, with illustrations. A carbon arc is fused as the illuminant with quartz optics, although the use of a mercury vapor arc and a glass system is conceded. Dark-field illumination is used with a condenser of the Abbe type plus a central stop. Primulin has proved to be a very satisfactory and effective fluorescent dye. R. P. L.

2512

Maintenance of Darkroom Temperatures. V. P. Williams. *Miniature Camera Mag.*, **2**: 175–77, February, 1938. In a small darkroom, the temperature of the solutions is maintained by standing the trays across a trap-door opening in the bench with an electric radiator below. A 500-watt radiator, set horizontally instead of vertically, can be supported underneath the bench at a height which enables the solution in a 10 by 12-inch tray to be maintained at 65° F. The red light emitted from the radiator shows no tendency to fog printing papers, but the radiator has to be temporarily switched off when using panchromatic plates which have not been desensitized. After desensitization, red light other than the direct radiation from the radiator has no tendency to fog even fast panchromatic plates. T. M. L.

256–257

An Automatic Syphon. F. H. Smith. *Brit. J. Phot.*, **85**: 37–8, January 21, 1938. A syphon for a tank for washing negatives or prints is constructed from a piece of glass tubing bent to form two inverted "u's," one having its maximum at a lower level than the other. A small hole, blown at the top of the lower "u," maintains the water in the tank at a constant level. The syphon may be adapted for use with a tray by bending the limb of the larger "u" to run along the bottom of the tray, sealing its ends, and blowing a number of fair-sized holes along its length. T. M. L.

X097

Historadiography. P. Lamarque. *Brit. J. Radiol.*, **11:** 425–35, July, 1938. Thin sections (less than 4μ) of biological material are radiographed with soft x-rays (2 A. to 12 A.) in a vacuum chamber attached to the special x-ray tube. The use of Lippmann-type emulsions permits magnifications of the image up to 900 diameters. R. B. W.

2624

Renovating a Focal-Plane Shutter. J. Southworth. *Brit. J. Phot.*, **85:** 53, January 23, 1938. A formula for a lightproof coating for fabric blinds which have developed pinholes is as follows: Artist's lampblack powder, 1 level spoonful; flexible collodion, 4 level spoonfuls; ether, 4 level spoonfuls. This preparation prevents the material from becoming tacky or too viscous. If a thinner mixture is desired, 4 spoonfuls of denatured alcohol are added to the above. The mixture should be rapidly applied with a brush over the whole surface of the blind, and it is inadvisable to go over the same surface twice or the coating may "lift" or rub up under the brush. T. M. L.

266

The Fluorescence of Light Filters. H. Bäckström and R. Johansson. *Z. wiss. Phot.*, **36:** 194–206, No. 8/9, 1937; *Atelier*, **44:** 210, November, 1937. The authors found fluorescence with gelatin and glass filters used in photography. This fluorescence, which is caused by absorption of ultraviolet light and the re-emission of light of longer wave length, appears as a general fog which causes loss of contrast. For gelatin filters, the fluorescence depends only on the dye and not on the gelatin or the Canada balsam used in mounting the filter. The greatest fluorescence is produced with aesculin filters. For glass filters, the fluorescence is more pronounced when the filter is lighter in color. For dark yellow and ultraviolet absorbing filters, the fluorescence is generally very small. In the case of filters composed of several components, the fluorescence depends very much on the orientation of the filter with respect to the light source. Filters may be tested by irradiating them with ultraviolet light and then photographing them through an ultraviolet absorbing filter. R. N. W.

2681–F5

M. C. M. Exposure Tables for Photoelectric Exposure Meters: How to Use Them. *Miniature Camera Mag.*, **2:** 191–95, February, 1938. Revised tables of meter settings are given for all the principal roll films and miniature films, indicating the variations required for 16 exposure meters. T. L. J. B.

06

The British Cinema in 1914. M. Seton. *Sight and Sound*, **6:** 126–28, Autumn, No. 23, 1937. The article, the third of a series on the history of the British cinema, describes briefly with quotations from the press, the topical films and war-propaganda films released at the outbreak of hostilities between August and December, 1914. K. G.

06

War. M. Seton. *Sight and Sound*, **6:** 182–85, Winter, No. 24, 1937–1938. The article, the fourth part of a series on the history of the British cinema, deals with the story of war films during 1914–1918. The American invasion of the British motion picture field, the

War Office films, the newsreels, and trick films are the main topics considered. A partial list of films produced in England from 1915 to 1920 is included.

0947

Microphotography. H. O. Burdick and D. W. Weaver, Jr. *Educational Screen,* **17:** 185–86, June, 1938. A device for producing 35-mm. film strips or Kodachrome slides was made by combining an Argus camera with an Eastman Recomar 33. A description with sketches is given in which an Argus minus the front lens is attached to a Recomar plate holder and a spring-out device is added for focusing. R. P. L.

231

Two New Photoflash Lamps Announced by General Electric. *Camera Craft,* **45:** 196, April, 1938. Two new photoflash lamps, both designed to produce a relatively long period of flash, are now available, the smaller of which is less than one-half the size of the smallest now in use. The filler consists of a small amount of aluminum wire and foil. The larger lamp, however, contains no wire but is filled with aluminum foil so treated that the flash produced is both longer and brighter than that from present lamps. G. T. E.

2682

Testing and Control of Exposure Meters. H. Staude. *Atelier,* **45:** 125–27, No. 7, 1938. The relative response of the meter to the varied intensity of the incident light is used as a measure of its accuracy. A black-lined box is placed behind the lamp while a number of cardboard shields are placed between the lamp and the meter to prevent the entrance of stray light. The variation in intensity is produced by changing the distance of the meter from the lamp. R. W. H.

K043

Three-Dimensional Color Pictures by Projection. G. W. Fox. *Camera* (Phila.), **57:** 92–4, August, 1938. The method suggested uses polarized light images on Kodachrome film. For action pictures, two standard cameras with identical lenses may be mounted side by side and the shutters tripped simultaneously. Properly oriented Polaroid filters are used over the taking lenses. The images are projected with Polaroid-equipped Kodaslide projectors and viewed with crossed-lens Polaroid spectacles. A metallic screen surface is necessary because polarization is completely destroyed on reflection from the customary screen materials. H. A. K.

056–089–X089

Photography and Radiography in the Service of Paleontological Research. J. Eggert, A. Frohlich, and F. Luft. *Veroffentl. wiss. Zentral-Labs. Phot. Abt., Agfa,* **5:** 283–89, 1937. The discussion is based on the photographic work done on the Geiseltal excavations. The specimens were associated with a layer of coal and it was difficult to obtain much brightness or color contrast. However, a suitable angle of illumination and proper filters yielded good results. Infrared exposures were used for very thin specimens. X-rays were, of course, valuable for their penetration and independence of surface peculiarities. Photographic methods had the advantage not only of furnishing permanent records but of disclosing features not visible to the eye. H. E. S.

Selected by permission of the Eastman Kodak Company from the Monthly Abstract Bulletin of the Kodak Research Laboratories.

ASSOCIATION NEWS
JUNE 1939

Convention Program Notes

THANKS to the suggestions coming from members, the Convention will be more of an Association than a committee product. The majority of votes on dates favored Thursday, September 14th to Saturday the 16th inclusive, so these days have definitely been chosen.

As the copy for this column must be in the Editor's hands several weeks before publication, no definite information can be given about the program as yet. The following are some of the plans that have more or less materialized, though subject to change:

Seven-Minute-Sessions. Short, completely practical papers on various technics in biological photography. Discussion of each paper also limited to seven minutes at the most, with longer general discussion at the end. Subjects will be chosen from members' suggestions. Mr. Schmidt, of the Rockefeller Institute, will preside.

Material on Surgical Filming. Mr. Julin has agreed to preside over the session and will also present a paper, probably on the editing of surgical films.

The Up-to-Date Scientific Photographic Department. We will endeavor to have both the small and large department discussed. Mr. Creer, of the Hines Veteran Facility and the Chicago Technigraphic Institute, will preside.

The March of Photography. Round table discussion of new equipment, emulsion changes, improved illuminants, etc. The manufacturing firms will be invited to have representatives at this session, each of which may have the floor for a limited time if he wishes. Formal addresses must be brief, however, as the main purpose of the session will be open discussion. Dr. Dillman, Jefferson Hospital, Philadelphia, will preside.

The Correct Use of Light Meters, Film Storage, various phases of *Photomicrography, Camera Insurance, Field Photography, X-Ray Motion Pictures, Endoscopic Photography, Legal Aspects of Scientific Photography,* and many other subjects have been suggested. And it is still not too late to send in suggestions, as there are always last minute changes.

The September number of the Journal will give further information. If you wish copies of the program write to the Secretary (University Office, Magee Hospital, Pittsburgh, Pa.). They will be available September 1st.

The Salon and Projection Evening. Please notice the paragraph in the Salon specifications about the projection of accepted transparencies during our Thursday evening session. Two or three interesting motion pictures will also be projected, titles to be announced later.

We are indebted to our member Mr. Hayden, F.R.P.S., of Victoria Hospital, McGill University, for suggesting to the R.P.S. that they participate in our Salon; and to that Society for accepting the invitation. An exhibit of overseas work will add interest, and should be valuable for study.

We would like to acquaint outstanding biological photographers with the work of this Association by asking them to exhibit in our Salon. If you know of photographers who should be invited we would greatly appreciate your dropping a line either to the Secretary or to Mr. Albert Levin, Montefiore Hospital, Pittsburgh, Pa., Chairman of the Salon Committee.

Medical Museum Photography

It is interesting to note that when the American and Canadian Sections of the International Association of Medical Museums met in Richmond in April, an entire session was devoted to photographic methods. Two of our members presented papers: Mr. Leonard Julin, in charge of the Section of Photography, Mayo Clinic, Rochester, Minnesota, spoke on "Recent Advances in the Photography of Gross Specimens"; and Mr. Carl Clarke, Associate Professor of Art and Director of the Department of Art, University of Maryland, Baltimore, Md., gave a paper entitled "Photographic Methods in Medical Illustration, Their Applications, Limitations and Substitutes." Exhibits showing photographic methods as applied to museum technic illustrated their communications.

American Standards Association

The American Standards Association has established a committee for the standardization of photography, sponsored by the Optical Society of America. Our Association is being represented by President Schmidt. It is planned that the American Standards will ultimately become the basis of International Standardization in this field. Other B.P.A. members at a recent meeting were: Mr. L. V. Foster of the Bausch & Lomb Company, and Dr. O. W. Richards of the Spencer Lens Company. The latter is chairman of one of the subcommittees.

P. A. A. Meeting

The 52nd annual convention of the Photographers' Association of America will be held at Buffalo, August 21 to 25 inclusive. Two State Associations, The Ontario Association of Photographers and the Professional Photographers' Society of New York, have decided to forego their separate 1939 conventions and join forces with the P. A. A. These two will hold private sessions of their own on August 22 and 23 respectively, at the Hotel Statler. The P. A. A. manufacturers' and dealers' exhibit and the picture exhibit, as well as the two concurrent morning and afternoon programs and numerous special sessions will be held at the 174th Regiment Armory. The Statler is the headquarters hotel.

A.R.P.S.

Mr. Ralph Creer, Chief Photographer of the Veterans' Facility, Hines, Illinois, has been admitted to the Associateship of the Royal Photographic Society of Great Britain.

The initials A.R.P.S. to which he is newly entitled appear after his name as author of an article on "Progress in Medical Photography" published in the January 1939 issue of *Clinical Medicine and Surgery*.

Happy New Year!

New Year's comes on July 1st, 1939, for every member of the B.P.A. It was decided some years ago to run all memberships as of July to July, no matter in what month applications were received, so that every member would receive a subscription to a complete Volume of the Journal. If an applicant comes in after one or more numbers of the current Volume have been published, the back numbers are sent him immediately on his election to membership. Those who apply when the year is two-thirds over are given the choice of becoming members for the current year and receiving the back numbers, or beginning their membership on the next July 1st.

All of which means that the present business and fiscal year ends June 30th. A notice to this effect with a renewal blank will be sent you about the middle of June. Last year—in fact every year—a number of members, on receiving their second renewal notices complained that they had never received the first notice, that they must have been away! This year the notices will be sent be-

fore even the early birds have left for vacation. Won't you help your Association to economize by sending in your renewal promptly? Follow-up notices take time and funds that would be more profitable to the members if spent in other ways!

Sustaining Members

The following are the Sustaining Members who help to finance the activities of your Association:

Mr. John F. Brooks
E. Leitz Company
New York City

The Fleischmann Laboratories
New York City

Mr. Louis Paul Flory
Boyce Thompson Institute for Plant Research
Yonkers, New York

Mr. Leonard Perskie
Defender Photo-Supply Co.
142 West 24th Street
New York City

Mr. Louis Schmidt
Rockefeller Institute
New York City

Dr. George H. Semken
16 West 85th Street
New York City

Miss Anne Shiras
University of Pittsburgh
Pittsburgh, Pennsylvania

Mr. H. W. Zieler
E. Leitz Company
New York City

New Members

We take pleasure in announcing the following new members:

Bridgmen, Jane (*C. T. Brues*), 10 Buckingham Place, Cambridge, Mass.

Carter, Ralph M., M.D. (*Leo Massopust*), 607 Bellin Bldg., Green Bay, Wis.

Howard, Joseph H., M.D., 144 Golden Hill, St. Vincent's Hospital, Bridgeport, Conn.

Lester, Howard D. (*Louis Schmidt*)**, 143 East 60th Street, New York, N. Y.

Millar, Richard (*Ralph P. Creer*)***, 1811 Wilshire Blvd., Los Angeles, Calif.

Moore, E. C., M.D. (*Louis Schmidt*)***, 511 First National Bank, Olean, N. Y.

Palmer, H. D., M.D., Rockford Hospital, Rockford, Ill.

Pudlak, Andrew (*Leonard Julin*), Pathological Laboratories, Woodville, Pa.
Reis, George Wm., 3325 Palmer Street, Chicago, Ill.
Reid, Edgar C., Experimental Station, Saanichton, B. C., Canada.
Ridgway, Ida M. (*William E. Patten and Adrian J. Iorio*), 274 Boylston Street, Boston, Mass.
Robinson, Wilton H., M.D. (*Dr. T. Helmbold*)*, 144 S. 20th Street, Pittsburgh, Pa.
Rockman, J., M.D. (*Dr. F. W. Joyce*), Fairfax Hotel, Fifth Avenue, Pittsburgh, Pa.
Rosenthal, Helman (*Louis Schmidt*)****, 2411 S. Harwood Street, Dallas, Texas.
Schiller, Arthur E., M.D. (*Frank Ruslander*), 419 Professional Bldg., Detroit, Mich.
Showstack, Paul J., 49 Browning Avenue, Dorchester, Mass.
Stephenson, Aaron, Jr., 608 Maloney Bldg., U. of P. Hospital, Philadelphia, Pa.
Tice, P. S., 4222 N. Leavitte Street, Chicago, Ill.
Vandegrift, Earl, M.D. (*Pittsburgh Chapter*)******, Columbia Hospital, Penn Avenue, Wilkinsburg, Pa.
Wallen, Walfred (*Ralph P. Creer*)****, 331 West 81st Street, Seattle, Wash.
Whitney, Chester A. (*F. R. Harding*), 47 Washington Street, Arlington Heights, Mass.

Honor Roll

The B.P.A. hopes that every member will bring in at least one new member. Here is a list of those who have filled their quota. When may we print your name?

Brues, C. T.	*	Julin, Leonard	*
Creer, Ralph P.	*****	Massopust, Leo	*
Forney, Emil	*	Meigs, R. C.	*
Foust, H. L.	*	Richards, Oscar	**
Harding, F. R.	*	Ruslander, Frank	*
Helmbold, Dr. T.	**	Schmidt, Louis	*****
Iorio, Adrian J. and		Skelton, David	*
Patten, Wm. E.	*	Pittsburgh Chapter	*******
Joyce, Dr. F. W.	*		

* Each asterisk designates a new member.

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